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Avian community changes along an urbanization gradient in Dar es Salaam, Tanzania, with a reversed trend for alien species

Jasson R. John and Qudra Kagembe

Summary

Dar es Salaam is the most populous city in Tanzania with over five million people, and has the fastest growing human population in East Africa. We examined the change in avian species richness and abundance along an urbanization gradient from city centre to peri-urban in order to provide insights into impacts of urbanization on native and non-native avifauna. Four major city exit/entry roads were used as reference transects in counting birds and recording selected urbanization indices at 63 circular points positioned at approximately 1 km intervals. A total of 1964 individuals from 71 species belonging to 36 families and nine orders were detected. Species-abundance patterns of native birds increased along the urbanization gradient from urban to peri-urban. However, the alien House Crow and House Sparrow showed reversed abundance trends from city centre towards peri-urban. These patterns were significantly related to the shift in urbanization indices; the number of pedestrians and vehicles, and percentage cover changes for buildings, pavements, bare land, and vegetation. Avian dietary guilds varied across the urban-peri-urban stretch and were significantly influenced by the vegetation cover. This study revealed that continuing urban development has a great impact on avian communities. We therefore recommend urban planning to be geared to controlling alien avian species population and increasing the vegetation cover.

Keywords: Alien species, biotic homogenization, dietary guilds, House Crow, urbanization

Introduction

The global human population continues to grow and is accompanied by rapid urbanization. Between 2011 and 2050, the world population is expected to increase by 2.3 billion, passing from 7.0 billion to 9.3 billion (United Nations 2011). At the same time, the population living in urban areas is projected to increase by 2.6 billion, passing 3.6 billion people in 2011 to 6.3 billion in 2050. Thus, the urban areas of the world are expected to absorb almost all the population growth expected over the next four decades while at the same time drawing in some of the rural population. By 2005, the global rate of urbanization (*i.e.*, the increasing number of people that live in urban areas) was 54%; Africa and Tanzania stood at 40% and 25%, respectively (Chen *et al.* 2014, Tacoli *et al.* 2015). Globally, human population growth and urbanization threaten the

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existence of ecological systems and biodiversity resources (Zari 2014, Parris 2016). According to Juffe-Bignoli *et al.* (2014) rising human population and urbanization are central to expanding the built environment.

Persistence of biodiversity in urban and peri-urban areas is determined by the rate of expansion of the built environment (Shirgaokar 2016). Urbanization results in a change in habitat which may challenge any particular wildlife population to exist. For birds, urbanization has a great impact on species abundance, richness, distribution, and community composition (Blair & Lawton 1987, Blair 2004). Urbanization has a complex direct impact on native avian communities (Miller *et al.* 2001). Many native bird species which fail to adapt to the new habitats become locally extinct from urbanized habitats. The factors that determine which of the bird species co-exist with humans in urbanized areas include the presence of vegetation cover (Emlen 1974, Rosenberg *et al.* 1987). Additionally, some bird species such as crows, sparrows, starlings, pigeons, and doves, take advantage of human disposal materials and waste both from industrial and residential areas and hence tend to increase in abundance when there is increased human settlement and activities (Leedy 1979), and some of these will reach the stage of becoming invasive (Mathews & Brand 2004).

Studies on the avifauna in urban environments (Miller *et al.* 2001, Blair 2004) have shown that urbanized areas have a high diversity of exotic species and a low diversity of endemic species. Further studies (Kareiva *et al.* 1993, Rija *et al.* 2004) that describe how native birds respond to this change suggest that urbanization affects landscape heterogeneity and consequently, the distribution, abundance and resources upon which birds depend. Most bird species are influenced by composition of vegetation, which forms most of their habitat, and in turn provides cover and food resources. Therefore, loss and alteration of native habitats may lead to an increase or decrease in species number (Lee & Rotenberry 2005). Vegetation in highly urbanized and residential areas mostly occurs in patches in the form of trees, shrubs and herbaceous plants and increases with gradient from urban to peri-urban (Leedy 1979, Jokimäki 1999).

Birds have been seen as a symbol for conservation globally for ecological and evolutionary reasons and they play a significant role in people's perception of the natural environment in which they live (Gibson *et al.* 2011); they provide cultural, provisioning, supporting and regulating services to urbanites (Huong & Thu 2017). Birds are highly sensitive, conspicuous and mobile, and thus very suitable as a measure in understanding the impact of humans on biodiversity (Chazdon *et al.* 2009), especially in urban areas (Miller *et al.* 2001, Njoroge & Ndang'ang'a 2010). Dar es Salaam is a highly expanding city with over five million people and this population increases by over 5% each year (NBS 2012). The city of Dar es Salaam therefore shows an increasing level of urbanization coupled with the growth of spontaneous settlements (Baker & Baker 2002, Abebe 2011) that pose a great danger to biological communities and survival of nature. Dar es Salaam is not only the largest city in East Africa, but it also hosts an Important Bird Area (IBA), the Dar es Salaam coast (Baker & Baker 2002). Despite the high rates of urbanization and rapid increase in population in African cities in which many of them are located in biodiversity hotspots (Chamberlain 2017), studies showing the influence of urbanization on biological communities are scanty. In this study we examined the change in avian species richness and abundance along an urbanization gradient from city centre to peri-urban in Dar es Salaam, and correlated the urbanization gradient indices with avian dietary guilds.

Materials and methods

Study area

Dar es Salaam is located in the eastern part of the Tanzanian mainland at 6°51′S latitude and 39°18′E longitude. It covers a total area of 1800 km^2, of which 1350 km^2 is landmass including its offshore islands; the remainder of the area is covered by water. It occupies 0.19% of the Tanzanian mainland, stretching about 100 km along the coast. The Indian Ocean borders it to the east, and the beach and shoreline comprise sand dunes and tidal swamps. The coastal shrubs, coastal swamps and mangroves, together with miombo woodland, represent the remnant natural vegetation type along the 100 km of coastline. Inland, the city is divided into three ecological zones, namely the upland zone comprising Pugu and other hills at 100–200 m in altitude to the west and north of the city, the middle plateau, and the lowlands areas (Dar es Salaam City Council 2004). Due to close proximity to the equator and the warm Indian Ocean, the city experiences tropical climatic conditions, typified by hot and humid weather with seasonal and daily variation throughout much of the year. The area experiences a bimodal pattern characterized by short rains from November to December and long rains during March and April. The average annual rainfall is approximately 1100 mm. Maximum relative humidity is high, 100%. The maximum reported temperature for Dar es Salaam is 35.3 °C in March; the minimum is 12.7 °C in August (Bargman 1970).

The human population of Dar es Salaam has increased from 2.5 million in 2002 to approximately 4.3 million in 2012, and is still increasing at a rate of 4.39% per annum, such that the metropolitan population is projected to reach 5.6 million by 2026 (NBS 2012). It was governed under three districts of Temeke, Ilala, and Kinondoni at the time of this study. The population in the metropolitan area grew from 843 090 in 1978 to 5465420 in 2016, of which 94% are urbanites (the urbanization rate being 34%) (Worrall *et al.* 2017). Development statistics place Dar es Salaam metropolitan as the most industrialized and urbanized city in Tanzania, as well as one of the top ten fastest growing cities globally (Ndetto & Matzarakis 2015). Approximately 70% of the people in Dar es Salaam live in congested and unplanned settlements, especially in lowland areas, and they are expanding towards the peri-urban. The increase of people has created an urban sprawl (Baker & Baker 2002, Abebe 2011; Fig. 1), with natural habitat fragmenting to very small remnants that cannot easily support biodiversity (Mkalawa 2016).

Nonetheless, due to the presence of the Indian Ocean coast, and remnants of the original coastal thickets, Dar es Salaam is very rich in bird species. About 500 bird species have been recorded in Dar es Salaam and its surrounding areas (Harvey & Howell 1987, Wium-Andersen & Reid 2000), and the city and coastline are therefore designed as an IBA (Baker & Baker 2002). Some of the bird species occurring in Dar es Salaam are introduced species that have arrived in different ways: some have escaped from the controversial bird trade including lovebirds, parrots, and barbets, while others such as House Crow *Corvus splendens* and House Sparrow *Passer domesticus* were probably introduced intentionally. The population of the House Crow has increased to hazardous levels since its introduction (Harvey & Howell 1987, Baker & Baker 2002, Kimario *et al.* 2020), and this crow is blamed for the disappearance of several native bird species from core urban areas (Wium-Andersen & Reid 2000, Baker & Baker 2002).

Study sites and methods

According to Gombe *et al.* (2017), the Dar es Salaam metropolitan-built environment development pattern is most extensive along the four main roads, namely Nyerere/ Pugu heading to the airport and Kisarawe district, Bagamoyo leading to Bagamoyo, Morogoro that heads to Morogoro region, and Kilwa that stretches southwards to Lindi and Mtwara regions. Kilwa and Bagamoyo roads run parallel to the shoreline while Pugu and Morogoro roads are almost perpendicular to the shoreline and lead towards the hinterland (Fig. 1).

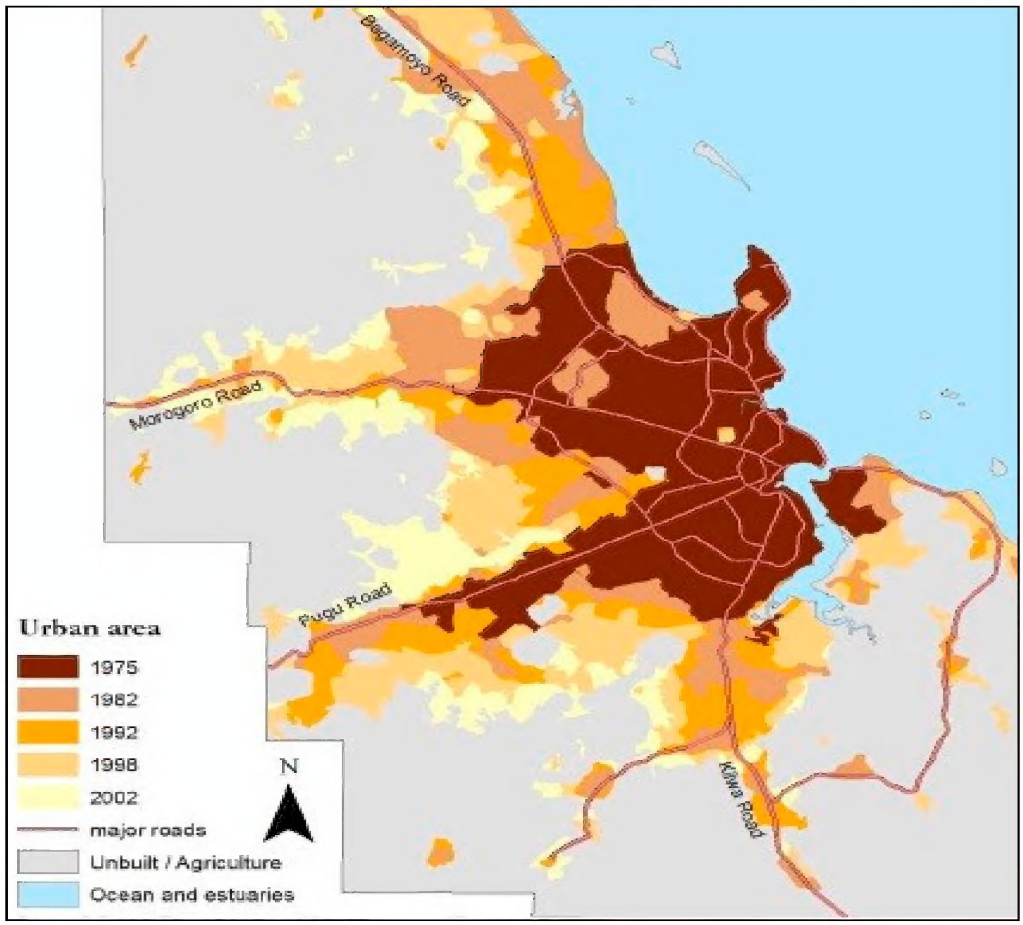

Figure 1. Urban sprawl in Dar es Salaam between 1971 and 2002 (Abebe 2011).

The four major roads feeding the city were used as transect lines (Table 1, Fig. 2). Survey points were located at an interval of about 1 km apart in each transect. Sometimes access to targeted sampling locations were denied by either buildings or restriction by owners, and the next close and suitable area was negotiated. These points were further placed beyond 100 m on either sides of the road (on open spaces with good visibility of up to 25 m from each direction) to avoid road bias from moving vehicles (Reijnen *et al.* 1995), noise pollution (Reijnen *et al.* 1995, Forman & Deblinger 2000, Wood & Yezerinac 2006), food and nutrients (Morgan *et al.* 2010) and vegetation strips along roads (Kociolek *et al.* 2011). A total of 20 minutes were

spent at each point; the first 10 minutes were used for counting birds and the last 10 minutes were used to record the urbanization indices. All census points were georeferenced by a hand-held GPS and plotted on a map (Fig. 2).

Table 1. Transect name, length and number of survey points along each transect.

Transect	Transect name	Road length (km)	Number of sampling points
Transect 1	Bagamoyo Road	27	17
Transect 2	Morogoro Road	30	18
Transect 3	Nyerere Road	20	14
Transect 4	Kilwa Road	21	14

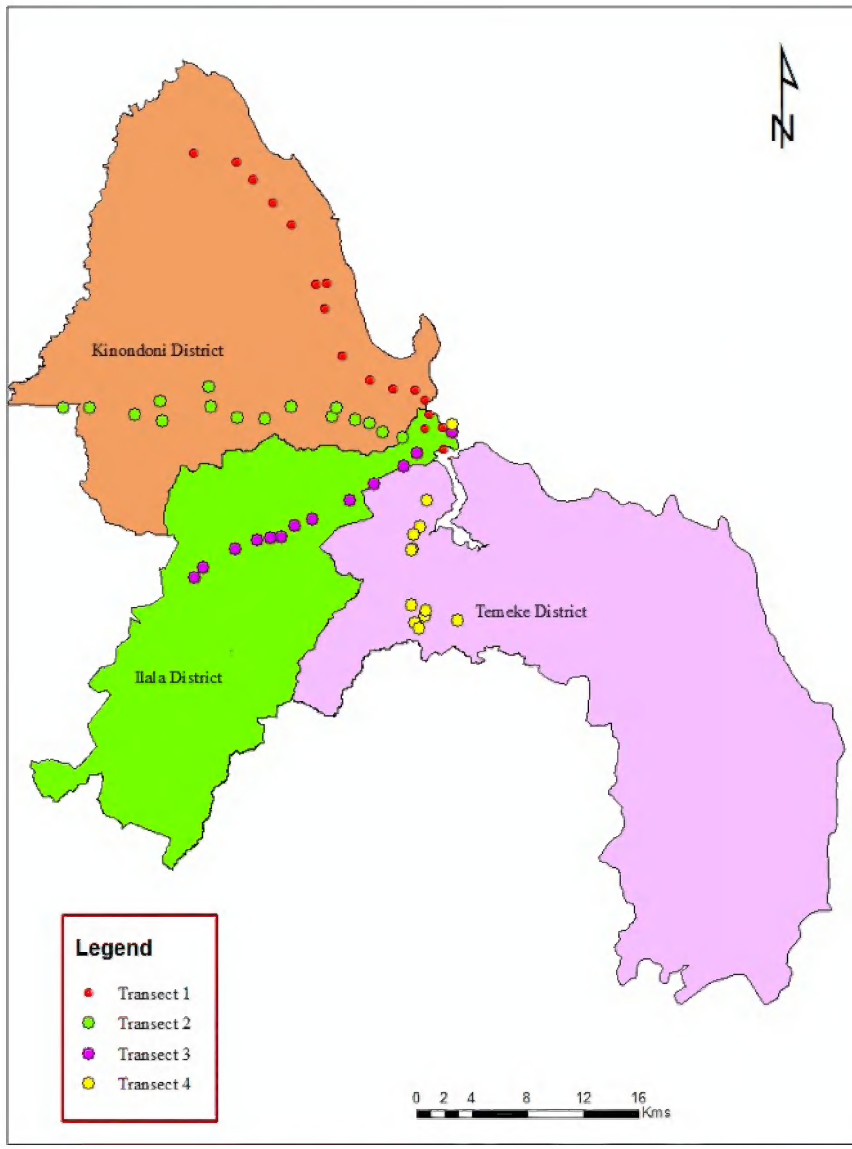

Figure 2. A map of Dar es Salaam showing transects and survey points. All transects started from city nuclei, near Dar es Salaam port.

All birds that were spotted within 25 m of the survey point were recorded (not much attention was put on birds in the air). Using a motorbike, each transect was surveyed twice during the same study period with reversed starting and ending points. We used binoculars (Bushnell 10 x 42) whenever needed to identify birds. The following urbanization indices were recorded within the 25 m radius: number of pedestrians and parked vehicles, and land cover (%) for pavements, building, vegetation, and bare land. Data collection was conducted between February and March 2016.

Data analysis

The average number of bird species from all points for all the four transects were plotted against the sampling points to obtain a line graph that shows how the species richness changed with urbanization. The same method was applied for abundance. Plotting of the House Crow and House Sparrow were also done excluding other species. Percentage cover of building, pavements, bare land and vegetation for all the four transects were used to plot a graph against distance from the city centre. Lastly line graphs to show how the number of pedestrians and vehicles changed with the urbanization gradient from the city centre to peri-urban were plotted. Pearson-product moment correlation coefficient was used to test for the linear correlation between birds and the urbanization indices, and species richness and abundances. The relationship between bird dietary guilds and urbanization indices was determined through direct gradient analysis using canonical correspondence analysis (CCA) in PAST version 4.03 (adopted from McCune & Mefford 1999). Dietary guilds were classified according to (Rija *et al.* 2014) (Appendix 1).

Results

Species richness and abundance patterns along the urbanization gradient

A total of 1964 individual birds comprising 71 species belonging to nine orders and 36 families were recorded along the urban-rural gradient (Appendix 1). The dominant families in terms of number of species were Estrilidae, Ploceidae, Nectariidae and Cisticolidae. Passerines constituted about 62% of all species observed. Several long-distance Palaearctic migrants were also recorded. They included Common Tern *Sterna hirundo*, Eurasian Golden Oriole *Oriolus oriolus*, Red-backed Shrike *Lanius collurio*, Lesser Grey Shrike *Lanius minor*, Great Reed Warbler *Acrocephalus arundinaceus*, Northern House Martin *Delichon urbicum* and Spotted Flycatcher *Muscicapa striata.*

The general trend showed an increase in species richness from the city centre to peri-urban. However, there were points with low and high peaks in species richness along the gradient (Fig. 3a,b). The abundance reduced from the city centre, flattening in between, and increased towards peri-urban habitats (Fig. 3c). On exclusion of the alien House Crow and House Sparrow, the abundance increased along the gradient of urbanization just as species richness did (Fig. 3d). Furthermore, species richness and abundance were significantly correlated ($r = 0.793$, $p = 0.009$) when House Crow and House Sparrow were excluded, and with a negative, but not significant correlation ($r = -0.283$, $p = 0.257$) when included. This suggested that the Central Business District (CBD) bird abundance was dominated by the two alien species, a sign of biotic homogenization, and their dominance decreased from the city centre towards peri-urban (Fig. 4).

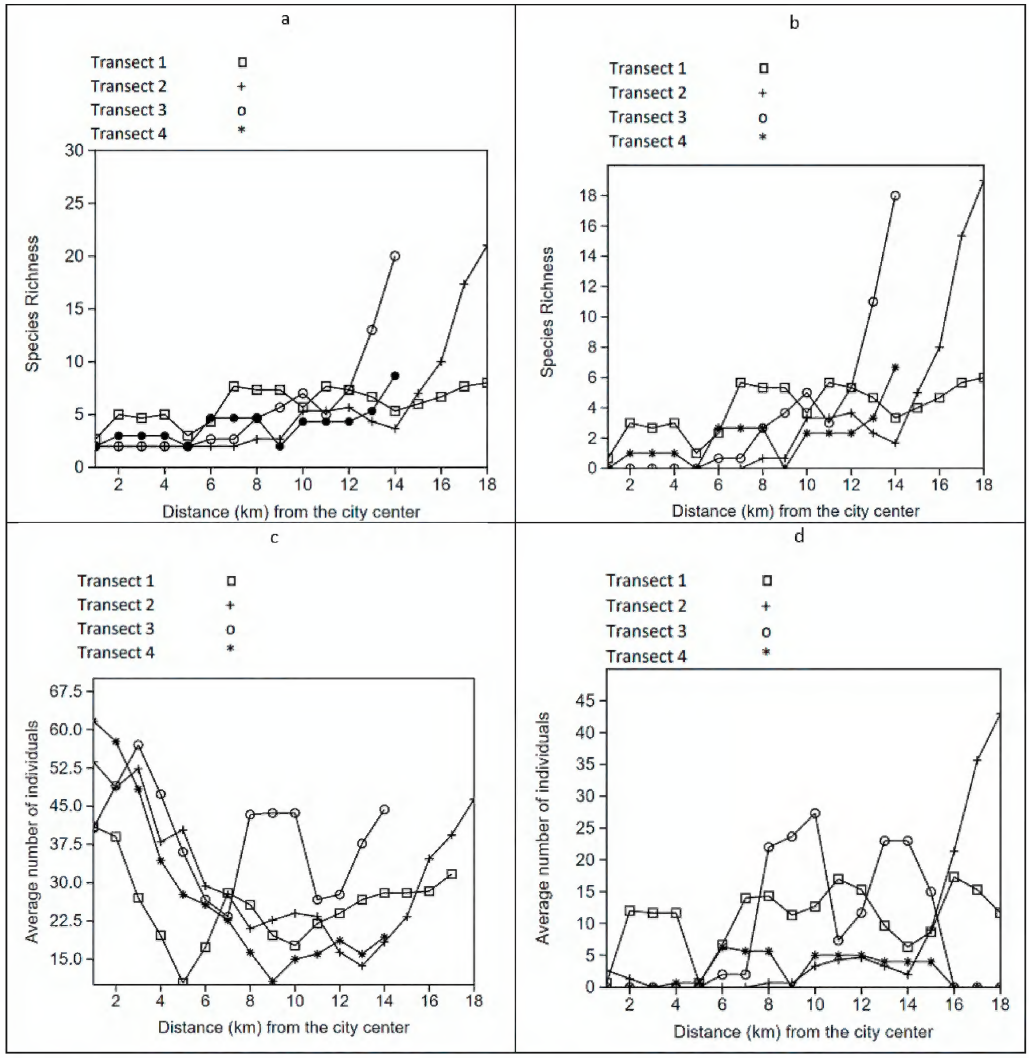

Figure 3. The patterns of bird species richness (a & b) and abundance (c & d) along the urbanization gradient in Dar es Salaam; (a) and (c) are with, whereas (b) and (d) are without, the two alien bird species, House Sparrow and House Crow.

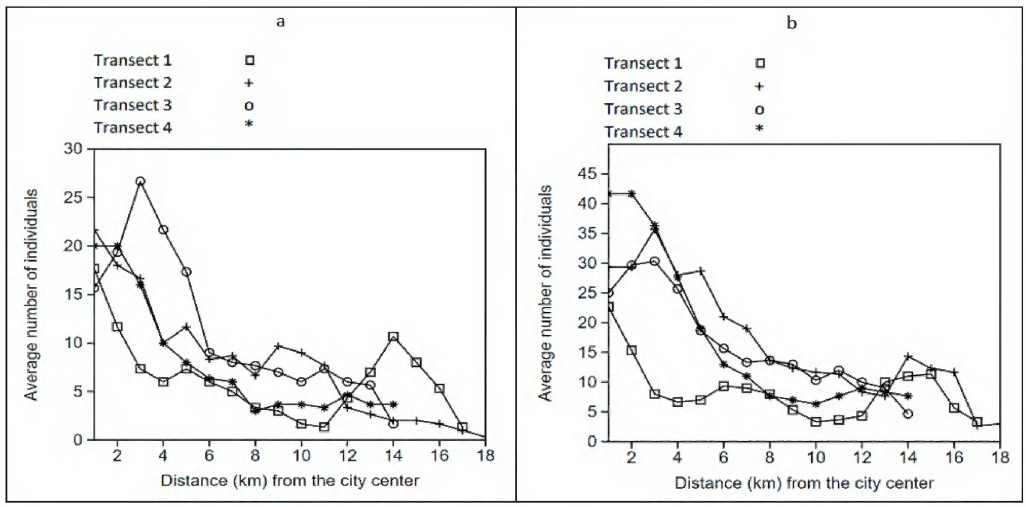

Figure 4. The House Crow (a) and House Sparrow (b) trends along the urbanization gradient from the city centre in Dar es Salaam.

Sampling points in natural patches (green spaces) had high species richness and a different composition of birds. In areas with wetlands (e.g. Msimbazi/Jangwani) and rivers and streams, species observed included Sacred Ibis *Threskionis aethiopicus*, Southern Masked Weaver *Ploceus velatus*, Hadada Ibis *Bostrychia hagedash*, Spectacled Weaver *Ploceus ocularis*, African Golden Weaver *Ploceus subaureus*, Wood Sandpiper *Tringa glareola*, Common Waxbill *Estrilda astrilda*, and Zanzibar Red Bishop *Eupletes nigroventris* (Appendix 2). A number of species were also found in vegetated open areas such as military barracks and cemeteries that included Bronze Mannikin *Lonchura culcullata*, Rattling Cisitcola *Cisticola chiniana*, Tawny-flanked Prinia *Prinia subflava*, Red-billed Firefinch *Lagonosticta senegela*, Blue-breasted Cordon-bleu *Uraeginthus angolensis*, Sombre Greenbul *Andropadus importunus* and Common Bulbul *Pycnonotus barbatus*. The only point that fell on the coastal beach (Selander Bridge, along Bagamoyo Road) had seabirds on the upper shoreline including Common Tern and Sooty Tern *Onychoprion fuscatus* (Appendix 2).

Urbanization indices and avian correlation

All the measures of land cover had a unimodal distribution except for the bare land which was low in highly urbanized areas, replaced by pavements and buildings. Generally, the percentage of area covered by building and pavements decreased while that of vegetation increased from the city centre to peri-urban (Fig. 5a). The number of parked vehicles and pedestrians decreased from city centre towards peri-urban (Fig. 5b). The percentage covered by buildings (r=-0.718, p=0.001) and pavements (r= -0.496, p=0.036), and number of vehicles (r=-0526, p=0.025), showed significant negative correlation with bird abundances, whereas vegetation (r= 0.748, p=0.0001) had a significant positive correlation. The correlation for species richness and urbanization indices was significant only with percentage cover by buildings (r=-0.632, p=0.005) and vegetation (r=0.603, p=0.008), respectively (Appendix 3).

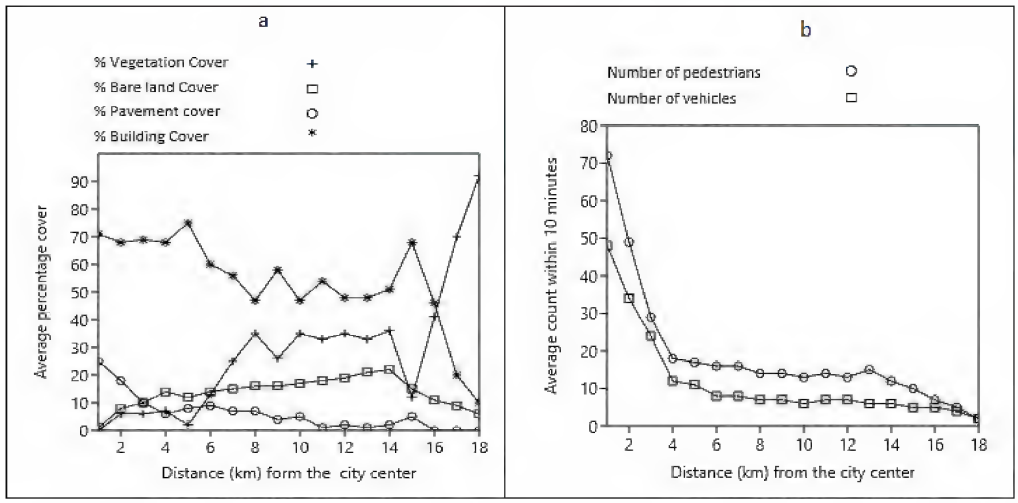

Figure 5. Urbanization indices from city centre to peri-urban in Dar es Salaam: percentages of land covered by buildings, pavements, bare land and vegetation (a) and the average number of pedestrians that were counted in ten minutes of time (b).

Influence of urbanization indices on bird species distribution

Bird dietary guilds were plotted against the axes of CCA plot to visualize their relationship with environmental variables. The CCA scatter plot (Fig. 6) detected a relationship between the distribution of bird dietary guilds and the percentage area covered by buildings, pavement, bare land, vegetation and the number of vehicles and pedestrians at the individual sampling points. In this study the first two ordination axes explained 83.1% and 11.4% of the variance in the species data with canonical eigenvalues of 0.793 and 0.107, respectively. The percentages indicate that the variation is well predicted by environmental variables. A Monte Carlo test using 100 permutations showed that the overall analysis and the two axes were significant (CCA, $p=0.0393$). Axis 1, which accounted for 83.9% of the variance, was very successful in showing the relationship between environmental variables and distribution of bird dietary guilds.

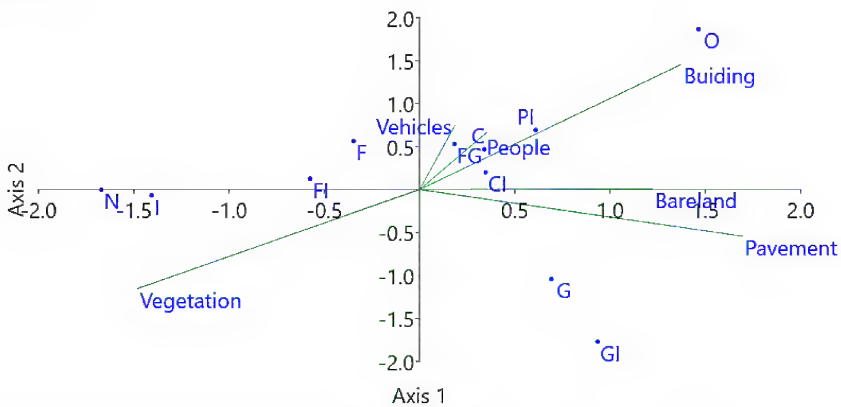

Figure 6. Ordination diagrams of canonical correspondence analysis. The arrows represent the direction of steepness of change of an urbanization index measure and are oriented towards the direction of the steepness increase of the index. The arrow length indicates the importance of the urbanization index in the model. The arrow direction indicates how well the index is correlated with various axes and the angle between axes indicate correlation. The location of bird dietary guilds relative to the arrows is determined by the impelling urbanization indices.

Dietary guilds that had the strongest positive association with Axis 1 were Omnivore (O) (r=1.444), followed by, Piscivore-insectivore (PI) (r=0.608), Frugivore-granivore (FG) (r=0.187), and Carnivore-insectivore (CI) (r=0.351). Also, positive association with Axis 1 were the percentage pavement cover (r=0.564), Building (r=0.451), Bare land (r=0.405), People (r=0.115), and Vehicles (r=0.058). Conversely, on a decreasing strength of association, Nectarivore (N) (r=-1.638), Insectivore (I) (r=-1.378), Frugivore (F) (r=-0.334), Granivore-insectivore (GI) (r=-0.556) were negatively associated with Axis 1. Percentage vegetation cover was also negatively associated with axis 1 (r=-0.487).

Generally dietary guilds for species that feed in more than one diet category including, Granivore-insectivores, Granivore-frugivores, Piscivore-insectivores, Frugivore-insectivore and guilds for species which can thrive well in urban habitats such as Omnivores (i.e. House Crow) and Granivores (i.e. House Sparrow) dominate the right portion of the plot. This part is also influenced by percentage cover for pavement, building, bare land, and number of people and vehicles. Insectivores, Frugivores and Nectarivores (i.e., sunbirds) fall in the left portion of the plot which is defined by the larger vegetation cover (Fig. 6).

Discussion

Species richness and abundance patterns along the urbanization gradient

Results from this study support the general hypothesis that while species richness increases from the city center to less urbanized habitats, native species' abundance decreases. This was correlated with the increase of vegetation cover from the city centre towards peri-urban. Species richness is usually lower in urban regions compared to rural areas, with the lowest diversities documented in urban core areas (McKinney 2002, 2008). In contrast, bird abundance had a bimodal pattern along the urbanization gradient where it started by decreasing from city and later increased as the urban habitats were changing to rural. This pattern was due to dominance of the two alien bird species, House Crow and House Sparrow, which were superabundant in urban core areas and whose numbers decreased from the city centre towards peri-urban but remained high in human populated town centres. This concurs with several studies (Nilon *et al.* 1995, Miller *et al.* 2001, van Rensburg *et al.* 2009, Chamberlain *et al.* 2017) which reported a decline in species with increasing urbanization but high abundance in a few species. In Pretoria, van Rensburg *et al* (2009) found few species in urban areas compared with semi-natural zones but lower abundance in semi-natural zones than urban, and the increase of the abundance in urban areas was a result of three alien bird species: Common Myna *Acridotheres tristis*, Feral Pigeon *Columba lavia,* and House Sparrow. However, a study in Kampala by Chamberlain *et al* (2017) on avian biomass did not find a correlation with urbanization gradient due to the presence of larger species in more urbanized areas. The bird communities in Kampala were increasingly dominated by scavengers, including the Marabou Stork *Leptoptilus crumeniferus*, exploiting human refuse.

Alien species, especially when they become an invasive, such as the House Crow in Dar es Salaam (Baker & Baker 2002), can stress and displace native urban adapters and could lead to biotic homogenization. The Pied Crow *Corvus albus*, for example, is becoming a rare bird in urban Dar es Salaam due to the competition with the House Crow. The Pied Crow used to be a common bird in Dar es Salaam area in mid 1980s

(Harvey & Howell 1987). The ecological impacts of the alien invasive House Crow in eastern Africa coastal areas have been intensively documented elsewhere (Ryall 1988, Archer 2001).

There were also ups and downs in the species-abundance patterns from city centre towards peri-urban. This was due to the presence of satellite urban centres and pockets of natural vegetation. The military base, wetlands, cemeteries, the university campus and gardens represent the few pockets of green spaces within Dar es Salaam. Birds usually take advantage of these natural remnants as refuge sites in response to urbanization (Emlen 1974). However, survey points that fell in populated centres such as Mbagala, Ubungo-Mbezi, Gongolamboto, had a lower bird species richness but a higher abundance, especially of the two alien bird species. This was due to the increase in buildings and pavements, with uncontrolled garbage disposal that favoured a few species of birds, especially the alien species. Such environments favour the few species that adapt to urban habitats and tolerant of human presence which are often exotics (Whitney & Adam 1980, Mathews & Brand 2004, van Rensburg *et al.* 2009).

Species richness peaked at the edge of the city and species found there were typically different from those found in urban areas and suburban areas (Appendix 2). These findings are supported by other studies (Graber & Graber 1963, Tomialojc 1970, Batten 1972, Emlen 1974, Guthrie 1974, Walcott 1974, Beissinger & Osborne 1982, Green 1984, Bezzel 1985, Rosenberg *et al.* 1987) but contrary to other findings (Huston 1979, Lancaster & Rees 1979, Aldrich & Coffin 1980, Jokimäki & Sauhenon 1993, Tilman 1982) which reported an increase in species richness at the intermediate levels of urbanization versus completely natural sites. This can be explained by the fact that this study (and most previous studies in urban areas) has examined species changes across relatively short distances. At the edge of the city, the percentage of land covered by vegetation was high compared to the percentage cover of buildings, pavements and bare land. This increase in vegetation cover and the presence of native vegetation at the edge of the city significantly increases diversity of food which, together with several other factors such as vegetation species composition, spatial scale and land use activities surrounding the areas of native vegetation, increase the likelihood and persistence of local native avifauna. Such habitats also act as stopover for long distance migrants.

Species composition, dietary guilds and urbanization

The results obtained from this study show that species composition also responded differently to the changes in resources brought by urbanization. Two alien species seen in the study had high abundances in the business and office areas though they were distributed throughout the study area. Normally these alien species, which reach high densities in urban areas, are tied to the urban and sub-urban development in their place of origin (Emlen 1974). The presence of wetland birds such as Cattle Egret, Hadada Ibis, Sacred Ibis, Wood Sandpiper, and Dimorphic Egret was attributed to the presence of swamps and riverine habitats that cross the city to the ocean. Such areas are frequently used by a diverse number of bird species for foraging, nesting and roosting due to the heterogeneity of microhabitats and available foods resources (Bradley 2001). This phenomenon was also reported by Emlen (1974), reporting water-dependent species flocking to Tucson's urban area because of the presence of pools and fountains.

It was observed from this study that most of the species in the study site were generalists; a likely effect of land use change in the study area. Harvey and Howell (1987) provide a detailed assessment of the birds of Dar es Salaam area which includes birds of dense coastal thickets such as Mouse-coloured Sunbird *Cyanomitra verreauxii*, Eastern Green Tinkerbird *Pogoniulus simplex* and Eastern Nicator *Nicator gularis* not encountered in this study. Granivores and omnivores had high abundances in the city centre. Omnivores mostly depend on human disposal for food and are favoured by the increase of human settlement. They survive on fruits from exotics, ornamentals and seeds, grain, bread, and scraps provided by people (Lancaster & Rees 1979, Tweit & Tweit 1986). The increase in vegetation cover towards the peri-urban supports the increase in number of insectivores and frugivores (Emlen 1974, Lancaster & Rees 1979, Beissinger & Osborne 1982). A few nectarivores, especially sunbirds, were found both in urban and peri-urban areas: this was due to the presence of green spaces and flowering plants in the city that provide food resources for most bird species.

Conclusion

The findings of this study suggest that the continuity of ex-urban development progressively reduces the habitats in which many bird species take refuge in response to urbanization and threatens their survival. Likewise, it has been observed that the superabundance of House Crow could pose a major threat to indigenous bird species and accelerate the avian homogenization in Dar es Salaam. Therefore, given the remarkable population increase of the House Crow in Dar es Salaam urban, and its known negative impacts in the East African coast, there is a need for long-term programmes to control its populations in urban areas, and for improved garbage management on which it depends for its survival. Despite the general increase of species richness from urban to peri-urban, some points with high species richness on more urban transects could be related to the presence of green patches and strips of vegetation. The existence of urban green spaces such as the military base, gardens, floodplains, and wetlands tend to buffer the effect of urbanization. These green spaces should be maintained, and the city authorities are encouraged to promote additional tree planting in both residential and public places.

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Appendix 1. Bird species recorded along the gradient of urbanization in Dar es Salaam including the dietary guilds: Granivore (G), Frugivore (F), Omnivore (O), Insectivore (I), Piscivore (P), Nectarivore (N), Carnivore (C), Granivore-insectivore (GI), Frugivore-granivore (FG), Piscivore-insectivore (PI), Frugivore-insectivore (FI), and Carnivore-insectivore (CI).

Common name	Species name	Dietary Guild
Red-eyed Dove	*Streptopelia semitorquata*	F
Ring necked Dove	*Streptopelia capicola*	FG
Emerald-spotted wood-dove	*Turtur chalcospilos*	F
White-browed Coucal	*Centropus superciliosus*	I
African Sacred Ibis	*Threskiornis aethiopicus*	CI
Hadada Ibis	*Bostrichia hagedash*	CI
Cattle Egret	*Bubulcus ibis*	PI
Grey Heron	*Ardea cinerea*	PI
Dimorphic Egret	*Egretta dimorpha*	PI
Great White Pelican	*Pelecanus onocrotalus*	C
White-fronted Plover	*Charadrius marginatus*	CI
Wood Sandpiper	*Tringa glareola*	CI
Sooty Gull	*Larus hemprichii*	PI
Sooty Tern	*Onychoprion fuscatus*	PI
Common Tern	*Sterna hirundo*	PI
Long-crested Eagle	*Lophaetus occipitalis*	C
Speckled Mousebird	*Colius striatus*	FG
Blue-naped Mousebird	*Urocolius macrourus*	FG
Little Bee-eater	*Merops pusillus*	I
Lilac-breasted Roller	*Coracias caudatus*	I
Grey-headed Kingfisher	*Halcyon leucocephala*	I
Brown-hooded Kingfisher	*Halcyon albiventris*	I
Striped Kingfisher	*Halcyon chelicuti*	I
Red-fronted Tinkerbird	*Pogoniulus pusillus*	FI
Spot-flanked Barbet	*Tricholema lacrymosa*	F
Brown-breasted Barbet	*Pogonornis melanopterus*	F
Cardinal Woodpecker	*Dendropicos fuscescens*	I
Eurasian Golden Oriole	*Oriolus oriolus*	I
Black-backed Puffback	*Dryoscopus cubla*	I
Orange-breasted Bush-shrike	*Chlorophoneus sulfureopectus*	I
Tropical Boubou	*Laniarius aethiopicus*	I
Fork-tailed Drongo	*Dicrulus adsimilis*	CI
Red-backed Shrike	*Lanius collurio*	I
Lesser Grey Shrike	*Lanius minor*	I
Eastern Black-headed Batis	*Batis minor*	I
Pied Crow	*Corvus albus*	O
House Crow	*Corvus splendens*	O
Green-capped Eremomela	*Eremomela scotops*	I
Bleating Camaroptera	*Camaroptera brachyura*	I
Rattling Cisticola	*Cisticola chiniana*	I

Common name	Species name	Dietary Guild
Tawny-flanked Prinia	*Prinia subflava*	I
Great Reed Warbler	*Acrocephalus arundinaceus*	I
Northern House Martin	*Delichon urbicum*	I
Lesser Striped Swallow	*Cecropis abyssinica*	I
Sombre Greenbul	*Andropadus importunus*	F
Common Bulbul	*Pycnonotus barbatus*	FI
Black-bellied Starling	*Notopholia corusca*	F
Spotted Flycatcher	*Muscicapa striata*	I
Collared Sunbird	*Hedydipna collaris*	N
Scarlet-chested Sunbird	*Chalcomitra senegalensis*	N
Purple-banded Sunbird	*Cinnyris bifasciatus*	N
Variable Sunbird	*Cinnyris venustus*	N
Zanzibar Red Bishop	*Euplectes nigroventris*	GI
Yellow Bishop	*Euplectes capensis*	GI
Spectacled Weaver	*Ploceus ocularis*	GI
African Golden Weaver	*Ploceus subaureus*	GI
Southern Masked Weaver	*Ploceus velatus*	GI
Village Weaver	*Ploceus cucullatus*	O
Red-billed Firefinch	*Lagonosticta senegala*	GI
African Firefinch	*Lagonosticta rubricata*	GI
Blue-breasted Cordon-bleu	*Uraeginthus angolensis*	G
Red-cheeked Cordon-bleu	*Uraeginthus bengalus*	G
Common Waxbill	*Estrilda astrild*	G
Bronze Mannikin	*Spermestes cucullata*	G
Black-and-white Mannikin	*Spermestes bicolor*	G
Village Indigobird	*Vidua chalybeata*	G
Cuckoo-finch	*Anomalospiza imberbis*	GI
House Sparrow	*Passer domesticus*	GI
African Pipit	*Anthus cinnamomeus*	I
African Pied Wagtail	*Motacilla aguimp*	I
Yellow-fronted Canary	*Crithagra mozambica*	G

Appendix 2. Distribution and abundance of bird species across the urbanization gradient in Dar es Salaam. Number of individuals and a census point are separated by a decimal point (e.g. 1.17, one individual was recorded at the 17 census point along a respective transect).

Common Name	Transect 1	Transect 2	Transect 3	Transect 4
Red-eyed Dove		1.18		
Ring necked Dove		1.18	3.14	
Emerald-spotted wood-dove	1.17		1.13	
White-browed Coucal				1.14
African Sacred Ibis			2.9	
Hadada Ibis			4.9	
Cattle Egret	3.3, 2.8, 2.14, 2.15, 1.16	1.17	2.7, 8.9, 1.10	1.11
Grey Heron	1.1, 2.8			1.14
Dimorphic egret	2.3			
Great White Pelican	1.3			
White-fronted Plover	3.3			
Wood Sandpiper				1.14
Sooty Gull	5.3			
Sooty Tern	17.3			
Common Tern	2.3			
Long-crested Eagle				1.11
Speckled Mousebird	5.11, 3.12	1.17, 3.18		4.3
Blue-naped Mousebird		1.17	1.11	
Little Bee-eater		1.16, 4.17	4.14	
Lilac-breasted Roller	1.12, 1.16		1.13, 2.14	1.14
Grey-headed Kingfisher	.15, 1.17		1.14	
Brown-hooded Kingfisher		2.18		
Striped Kingfisher		1.16, 1.17		
Red-fronted Tinkerbird			1.14	
Spot-flanked Barbet			2.14	
Brown-breasted Barbet		1.11		
Cardinal Woodpecker	1.8, 1.17			
Eurasian Golden Oriole		3.18		
Black-backed Puffback		1.18		
Orange-breasted Bush-shrike		1.18		
Tropical Boubou		2.13, 3.14		
Fork-tailed Drongo		2.17, 2.18	2.14	
Red-backed Shrike			1.13	
Lesser Grey Shrike		1.18		
Eastern Black-headed Batis			2.14	
Pied Crow			1.7	
House Crow	21.1, 11.2, 3.3, 6.4, 7.5, 7.6, 4.7, 4.8, 2.9, 3.10, 1.12, 7.13, 8.14, 12.15, 8.16, 1.17	20.1, 5.2, 9.3, 16.4, 5.5, 14.6, 6.7, 6.8, 8.9, 15.10, 4.11, 4.12, 2.13, 2.14, 3.15, 2.16	12.1, 23.2, 23.3, 34.4, 8.5, 10.6, 9.7, 5.8, 9.9, 7.10, 2.11, 13.12, 3.13, 1.14	18.1, 24.2, 18.3, 6.4, 6.5, 12.6, 1.7, 5.8, 3.9,.10, 5.11, 2.12, 7.13, 2.14

Common Name	Transect 1	Transect 2	Transect 3	Transect 4
Green-capped Eremomela		1.18		
Bleating Camaroptera		1.17	1.13	
Rattling Cisticola	2.8, 1.17	2.9, 2.14, 1.17, 2.18		1.7, 1.11
Tawny-flanked Prinia	1.8, 1.17	1.11, 2.18	1.13	1.14
Great Reed-warbler		1.17	5.13	
Northern House Martin	1.10			
Lesser Striped Swallow				3.7
Sombre Greenbul	1.8	1.18		
Common Bulbul	1.13, 1.16, 1.17	1.17, 4.18	1.13	1.14
Black-bellied Starling		1.14		
Spotted Flycatcher			1.14	
Collared Sunbird	1.5, 1.6, 1.11, 1.16	1.14, 2.18, 1.17		
Scarlet-chested Sunbird	1.8, 1.12, 1.17	1.16, 1.18	1.13	
Purple-banded Sunbird	1.8			
Variable Sunbird	1.18			
Zanzibar Red Bishop	8.8, 10.11, 4.17	7.16, 12.17, 9.18	3.7, 40.9, 3.13, 2.14	1.3, 4.7, 3.11
Yellow Bishop	1.17	5.17, 4.17	3.13	
Spectacled Weaver				1.7
African Golden Weaver	2.8, 2.11	3.16	2.10, 2.14	2.7
Southern Masked Weaver	1.3			
Village Weaver	1.17	1.17		
Red-billed Firefinch	2.10, 3.11, 3.14, 2.15	4.12, 2.16, 2.18	2.10, 2.11, 2.14	2.11, 4.14
African Firefinch		1.16		
Blue-breasted Cordon-bleu	2.11, 3.14	1.9, 1.11, 1.13, 8.17, 2.18	3.14	2.14
Red-cheeked Cordon-bleu	2.7, 1.8, 2.10, 2.12, 2.13, 2.16, 13.17	4.10, 2.11, 2.13, 3.14		
Common Waxbill			3.14	
Bronze Mannikin	1.6, 2.9, 4.10, 6.12, 6.16	2.11, 4.17, 5.18,	5.9, 2.10, 5.13	4.7, 4.11
Black-and-white Mannikin	2.12			
Village Indigobird	1.13, 1.14, 2.17	2.11	2.14, 2.17	2.11
House Sparrow	28.1, 12.2, 6.3, 8.5, 7.6, 13.7, 7.8, 4.9, 5.10, 4.11, 5.12, 12.13, 18.14, 8.15, 4.16, 1.17,	8.1, 40.2, 24.3, 43.4, 17.5, 26.6, 20.7, 11.8, 10.9, 16.10, 9.11, 9.12, 7.13, 7.14, 29.15, 1.16, 2.17, 1.18	19.1, 37.2, 33.3. 21.4, 23.5, 12.6, 12.7, 16.8, 13.9, 10.10, 8.11, 18.12, 4.13, 5.14	41.1, 43.2, 23.3, 25.4, 19.5, 15.6, 7.7, 11.8, 5.9, 5.10, 9.11, 9.12, 9.13, 7.14
African Pipit	2.3			
African Pied Wagtail	1.17			
Yellow-fronted Canary			2.14	

Appendix 3. Correlation of bird abundance, species richness, and urbanization indices in Dar es Salaam.

Urbanization indices	Abundance		Species Richness	
	p value	r value	p value	r value
Building	0.001	-0.718	0.005	-0.632
Pavement	0.036	-0.496	0.084	0.417
People	0.055	-0.473	0.088	-0.412
Vehicles	0.025	-0.526	0.08	-0.421
Bare land	0.131	0.37	0.109	-0.39
Vegetation	0.0001	0.748	0.008	0.603

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Notes on the assemblage of forest birds at Oloitokitok, Mt. Kilimanjaro, including a new species for Kenya

James E. Bradley, Isaac Kilusu, Peter Steward, Tyler P. Davis and Victor J. Ikawa

Summary

Observations of birds from previously unknown and apparently overlooked forest remnants at Oloitokitok in southeast Kenya are presented. Several forest specialists reported have very limited ranges in Kenya, such as Bar-throated Apalis *Apalis thoracica*, Stripe-faced Greenbul *Arizelocichla striifacies* and Kenrick's Starling *Poeptera kenricki* while the *guttifer* subspecies of White-stared Robin *Pogonocichla stellata* and Broad-ringed White-eye *Zosterops eurycricotus*, both formerly endemic to Tanzania, are documented in Kenya for the first time.

Keywords: Forest birds, endemics, White-eyes, Mt. Kilimanjaro, Oloitokitok

The avifauna of Mt. Kilimanjaro is well known (Moreau & Sclater 1935, Moreau & Moreau 1939, Cordeiro 1994). However, the precise distributions of forest species on the northern slopes with respect to the international Kenya-Tanzania border are less well documented. In the vicinity of Oloitokitok (2°55′34″ S, 37°30′22″ E), approximately 1 km from the Tanzania border at an altitude of 1750 to 1950 m, small corridors and patches of remnant montane forest are preserved along streams and on private land. These have not previously been surveyed for birds, and regional distribution maps (e.g., Lewis & Pomeroy 1989, Zimmerman *et al.* 1996) do not indicate the presence of forest specialist birds in this part of Kenya.

The indigenous forest surviving at Oloitokitok is typical of many other montane forests in the region and is best classified as montane mesic and dry evergreen forest, following a delineation of vegetation belts on Mt. Kilimanjaro given by Pócs (1991). Fragments of forest covered here are scattered throughout the study area but primarily occupy two larger stream valleys supporting forest cover extending up to 1.5 km in length and 90 m in width on the Kenya side of the border. Of these two main drainages, evergreen forest cover along the Njoro River (2°55′43″ S, 37°28′21″ E) at the western extent of the study area covers an altitudinal range of 1825–1950 m, while forest along the Nalemoru River (2°57′12″ S, 37°30′48″ E) at the eastern extent covers an altitudinal range of 1750–1850 m (Fig. 1). Owing to the moister microclimate, floristic diversity in these valleys is high, with prominent tree genera and/or species including *Albzia* sp, *Croton macrostachyus, Croton megalocarpus, Celtis africana, Cusonia holstii, Ficus thonningii, Juniperus procera, Olea europaea* and *Podocarups* sp. An additional, small privately owned forest fragment is situated between the two river valleys on more level ground in the vicinity of the Outward-Bound School

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(2°56′37″ S, 37°30′27″ E). This forest fragment covers approximately 25 ha at approximately 1850 m, and is less floristically diverse than the river valleys, being dominated by *Juniperus procera*, *Cusonia holstii* and *Croton megalocarpus*. While the riverine valleys are also better connected to contiguous forest habitat on the Tanzanian side of the border, the forest at the Outward-Bound School is more isolated, being separated from forest in Tanzania by old coniferous plantations. All forest fragments covered here can be encompassed in a roughly 8 x 2 km^2 rectangle abutting the border and extending either side of the town of Oloitokitok.

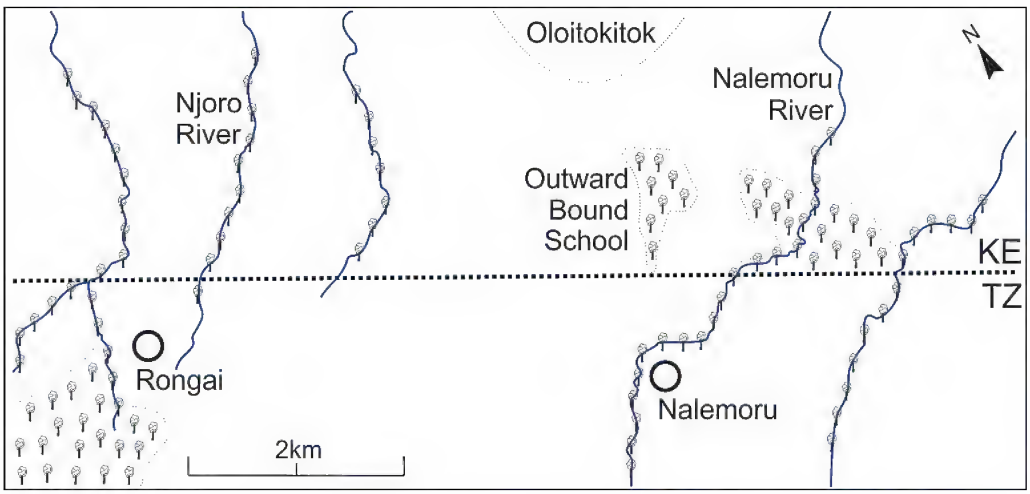

Figure 1. Map of the study area showing indigenous forest remnants and streams flowing north into Kenya, between the international border and the town of Oloitokitok.

Observations have been made intermittently in the vicinity of Oloitokitok from 2015 to 2021 mostly by IK, while short visits in 2020 and/or 2021 were made by the remaining authors with the intention of securing photographic documentation of some species. The purpose of this short paper is to provide some information on the occurrence of forest birds at Oloitokitok that is of distributional interest. All records were compiled by JEB, and taxonomy and nomenclature followed is that of Gill *et al.* (2021). Comments on regional occurrence are based on Zimmerman *et al.* (1996) unless stated otherwise, and it should be noted that most species reported here are commonly found on the Tanzanian side of the border (Cordeiro 1994) and are therefore not unexpected records for this area.

Hartlaub's Turaco *Tauraco hartlaubi*

A common resident of taller trees in all forest fragments, with up to six observed together in August. Within forest areas it preferentially seeks areas of thicker canopy cover, being less frequently encountered where trees have been selectively felled and forest cover is thinner. It is known from nearby in Kenya on the Taita and Chyulu Hills.

Green Malkoha *Ceuthmochares australis*

A rare intra-African passage migrant with a single record from 1850 m at the Outward-Bound forest on 7 August 2021. Elsewhere in interior southern Kenya and

Tanzania border regions it is similarly rare with scattered records from Kibwezi, the Chyulu and Taita Hills, and Kitovu Forest, as well as a single record from the western slopes of Mt. Kilimanjaro on 7 September 1990 (Cordeiro 1994).

Blue-spotted Wood Dove *Turtur afer*
A fairly common resident of forest edge and adjacent well wooded gardens. Although present in central Kenya as far east as Lakes Nakuru and Naivasha in the central Rift Valley, this species is hitherto unknown from areas of Kenya east of the Rift Valley.

Mountain Buzzard *Buteo oreophilus*
A scarce visitor that is unlikely to be resident or breeding locally on Kenyan soil. Records of single birds have been in May and November, down to the lower altitudinal limits of the study area at *c.* 1800 m.

Golden-tailed Woodpecker *Campethera abingoni*
A scarce (probably) resident of forest edge in the study area as well as in small strips of groundwater forest to the northeast of Oloitokitok. The subspecies present here is the eastern from *suahelica*, and our only dated records are in May and August. Nearby presence in Kenya is known from Taveta, ranging north very locally to Nairobi (B. Finch, in Hunter 2021) and Kijabe (J. Davis pers. comm., September 2021).

Black-fronted Bushshrike *Chlorophoneus nigrifrons*
Presumably a local and uncommon resident, with two records from the Nalemoru River, one reliably dated to the month of November. Apparent presence in only this river valley may be related to this site's higher degree of connectivity with forests in Tanzania, than that of other fragments in the study area. Nearby in Kenya, this bushshrike is a rare resident on the Chyulu and Taita Hills.

Blue-mantled Crested Flycatcher *Trochocercus cyanomelas*
Probably a scarce and local resident in thicker forest habitats found in the stream valleys. Our two records of the subspecies *bivittatus* are from the months of October and November, in the Njoro River Valley, and the valley of a small proximal stream to the east. Cordeiro (1994) notes this species to be local and uncommon on Mt. Kilimanjaro, with previous records from only the lower elevations of the southern and southwestern slopes. An audio recording of birds at Oloitokitok has been archived at the Macaulay Library (ML #392823761), and presence in nearby Kenya is also known from the Chyulu and Taita Hills.

Mountain Greenbul *Arizelocichla nigriceps*
Singles and pairs of the nominate subspecies have been observed at the Outward-Bound forest and along the Njoro River in November, with a pair at the latter site observed nest-building (Fig. 2). Oloitokitok is the only known site in Kenya east of the rift valley where this species is found, with an old report from the Taita Hills being doubtful in the absence of subsequent records, and more likely to have involved a juvenile *A. striifacies* (J. Bradley & B. Finch *in litt.*).

Stripe-faced Greenbul *Arizelocichla striifacies*
The nominate subspecies is a common resident throughout forest areas, and

easily located by its repetitive call (Fig. 2). Pairs typically favour the lower forest mid-storey, and breeding at Oloitokitok is confirmed by way of an adult observed carrying food to a nest in November. Elsewhere within its strictly southern distribution in Kenya, this species is found on only the Chyulu and Taita Hills, and at Ol Doinyo Orok (Namanga Hill). Similar to those birds, *striifacies* on Mt. Kilimanjaro shows pale blue-grey irides, readily distinguishing them from birds in the Usambara and wider East Arc Mountains (also treated as *striifacies*) to the south that show a hazel brown iris. See Dowsett (1974), Dowsett & Dowsett-Lemaire (1993) and del Hoyo & Collar (2016) for comments on eye colour within this species complex.

Placid Greenbul *Phyllastrephus placidus*

A fairly common resident of all forest areas, inevitably vocal, in pairs and family groups, and favouring the understory to the lower mid-story but also commonly on the ground. On occasion, birds are observed entering mature coniferous plantations separating stream valleys, and may be tolerant of some habitat modification.

Cinnamon Bracken Warbler *Bradypterus cinnamomeus*

A fairly common resident of thick understorey and forest edge, and which is most often found above 1900 m along streams. Previously, birds on Mt. Kilimanjaro have been treated as the subspecies *rufoflavidus* (elsewhere in Kenya only in the Chyulu Hills) by Britton (1980) and Zimmerman *et al.* (1996), but which are now widely included within the nominate form.

Bar-throated Apalis *Apalis thoracica*

Pairs are fairly common but local residents of forest areas with a thick understorey of tangled creepers, and are most often seen at the Outward-Bound forest and along the Njoro River (Fig. 2). This species is known elsewhere in Kenya from only the Chyulu Hills and the subspecies concerned in both cases is *griseiceps*.

Figure 2. Photographs of Mountain Greenbul *Arizelocichla nigriceps nigriceps* (top left: J. Bradley), Stripe-faced Greenbul *Arizelocichla striifacies striifacies* (top right: P. Steward), Bar-throated Apalis *Apalis thoracica griseiceps* (bottom left: V. Ikawa) and White-starred Robin *Pogonocichla stellata guttifer* (bottom right: J. Bradley), at Oloitokitok, Kenya.

African Hill Babbler *Sylvia abyssinica*

The nominate subspecies is a common and vocal resident of understorey and lower mid-storey tangles in all forest fragments, with a maximum of six birds recorded counter-singing on a site visit in May.

Broad-ringed White-eye *Zosterops eurycricotus*

A common resident of forest, forest edge, overgrown coniferous plantations and wooded gardens throughout the study area (Fig. 3). Most birds present at Oloitokitok show the characteristic sepia-brown supercilium of this species (vs. golden-yellow in *Z. mbuluensis*) contrasting with a slightly brighter yellow throat (contrast lacking in *mbuluensis*), as well as some greyish tones on the olive-yellow flanks. Some birds, however, simply show a dull olive forecrown and no obvious supercilium, as in those birds on nearby Mt. Meru (in Tanzania) originally described under the name *Zosterops meruensis*, and which are now universally treated as a synonym of *eurycricotus*. We note, however, that the appearance of the forecrown and/or supercilium in all birds in the field is subject to the angle of view and brightness of light, and that some individuals can be misleading in appearing to show a yellower forecrown, and thus superficially resembling *Z. mbuluensis*.

Broad-ringed White-eye is unrecorded in Kenya previously and the photographs presented here support the first documented occurrences of a species previously regarded as being endemic to Tanzania (Britton 1980, Zimmerman *et al.* 1996). Breeding in May is confirmed by way of observations of adults feeding fledged young, and adults tending young in a nest built in an exotic Cypress tree adjacent to indigenous forest.

Figure 3. The first Kenya records of Broad-ringed White-eyes *Zosterops eurycricotus* comprising birds photographed at Oloitokitok, Kenya (top left and bottom: T. Davis, top right: V. Ikawa).

Waller's Starling *Onychognathus walleri*
A rare visitor from more extensive forests on the Tanzanian side of the border. Our only record is of a singing bird in March at the Outward Bound forest. This species is common in central Kenya but is absent from both the nearby Chyulu and Taita Hills. Birds on Mt. Kilimanjaro are of the nominate subspecies.

Kenrick's Starling *Poeoptera kenricki*
The nominate subspecies is presumably an uncommon visitor from more extensive forest on the Tanzanian side of the border, with only two records of birds along the Njoro and Nalemoru Rivers in November. In each case, the birds (a single and a pair) were found perched on dead branches atop tall forest trees, and were identified by way of a pale eye, fairly dull plumage, slender appearance and sweet "*turlee*" calls most similar to those of Stuhlmann's Starling *P. stuhlmanni*. Elsewhere north of Mt. Kilimanjaro, this range-restricted starling is found only on the south and east slopes of Mt. Kenya, and the south slopes of the adjacent Nyambeni Hills, in central Kenya.

Abyssinian Thrush *Turdus abyssinicus*
Common in forest and forest edge habitat, ranging into overgrown Cypress plantations and gardens. The subspecies here, *T. a. deckeni*, is otherwise known in Kenya from nearby Ol Doinyo Orok, but recent photographs of birds from the Chyulu Hills, originally described as *chyuluensis* (Macaulay Library #114614921; S. Dolrenry), suggest those are also best treated with *deckeni*.

White-starred Robin *Pogonocichla stellate*
A common but shy resident of thick understorey in all forest fragments, where it commonly forages on the ground (Fig. 2). The subspecies here is *P. s. guttifer*, which is endemic to Mt. Kilimanjaro and Mt. Meru, and is previously unrecorded in Kenya. Breeding is confirmed by way of adults observed feeding recently fledged young in May and August.

Olive Sunbird *Cyanomitra olivacea*
The subspecies *C. o. neglecta* is a fairly common resident of forest and forest edge, extending to thickets and large trees in surrounding agriculture. It may have a largely continuous distribution with the population in the Chyulu Hills.

Abyssinian Crimsonwing *Cryptospiza salvadorii*
The subspecies *C. s. kilimensis* is a fairly common resident of edge and leafy thickets in all forest fragments but especially along the streams, where up to four have been observed together. Elsewhere in southern Kenya this species has been recorded at nearby Ol Doinyo Orok (Namanga Hill) and on the Chyulu Hills.

Thick-billed Seedeater *Crithagra burtoni*
A fairly common resident in singles and pairs, frequenting forest and well wooded areas with some understorey. The subspecies here is *C. b. kilimensis* (type locality Mt. Kilimanjaro), which is common in parts of western Kenya but is unknown elsewhere in Kenya east of the Rift Valley, where it is otherwise replaced by *C. b. albifrons*.

The records presented here confirm the persistence of some indigenous forest remnants and a representative sample of regional Afromontane forest birds at

Oloitokitok. These small fragments are particularly important nationally, in comprising the only site for Broad-ringed White-eye in Kenya, otherwise known from only Tanzania. It seems possible, on occasion at least, that other species known to occur on Mt. Kilimanjaro but as yet unreported in Kenya may also occur in these small forests. Such taxa include Olive Woodpecker *Dendropicos griseocephalus* and Kretschmer's Longbill *Macrosphenus kretschmeri*. Field observers should be attentive to the possible presence of these, and other, noteworthy species. Oloitokitok is also conveniently located between the National Parks of Amboseli and Tsavo West, thus also offering the potential for the development of some ecotourism services to cater to travelling birders.

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Diurnal time-activity budget and habitat use of Wattled Crane *Bugeranus carunculatus* in Boyo Wetland and Bale Mountains National Park, Ethiopia

Hadis Tadele, Afework Bekele and George Archibald

Summary

The diurnal time-activity budget and habitat use of the Wattled Crane *Bugeranus carunculatus* were studied at Boyo Wetland and Bale Mountains National Park. The study was carried out in four habitats (agricultural land, grassy field, mudflat, and shallow wetland) at Boyo Wetland and two habitats (grassland and swampy habitat) in the Bale Mountains. Instantaneous scan sampling was used to collect the daily activity time budget, scanning each individual in turn and categorizing its behaviour in six behavioural states. We made observations from 06:00 to 18:00 from October through June 2014/2016 and 2016/2017. We performed ANOVA and T-test to look at how diurnal activity pattern differed among habitat types and time periods of the day. Foraging was most prevalent, accounting for 39% of the time budget followed by locomotion (20%) and vigilance (16%) and social behaviour (2%). The time spent on various activity patterns across habitats and between seasons were significantly different ($p < 0.05$). Across habitats, the daily pattern for foraging and locomotion showed two peaks, in the agricultural habitat and grassland habitats, whereas percent time devoted to vigilance, resting and comfort movement followed an inverse pattern, peaking at mudflats and shallow wetland. The Wattled Crane spends more time feeding on farmland than in the wetland. This could create conflict with farmers and threaten the Wattled Crane. Therefore, urgent actions are needed to restore the degraded wetlands.

Keywords: Bale Mountains, Boyo Wetland, time-activity budget, foraging, Wattled Crane

Introduction

The Wattled Crane *Bugeranus carunculatus* is the largest and rarest of the six African crane species and is one of the most wetland-dependent species of all African cranes (Meine & Archibald 1996). It is classified as Vulnerable in the revised IUCN Red List of threatened species with a decreasing population (IUCN 2019). Historically it was more numerous, with an estimated population of 13 000–15 000 in 1985 (Beilfuss *et al.* 2007; Bento *et al.* 2007), distributed across eleven African countries (Johnsgard 1983). However, records from the 1970s to the 1990s show that the species experienced a significant decline across its range (Meine & Archibald 1996), largely due to loss and degradation of wetland habitat (Konrad 1981). Currently, there are isolated

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populations in South Africa and Ethiopia, and a larger, widespread, floodplain population in south-central Africa, cumulatively amounting to fewer than 9600 (Morrison 2019).

Due to their morphological appearance, behaviour, and their cultural significance, cranes in general have been intensively studied for many years throughout the world from their ecology to their movements using satellite tracking (Harris 1994, Harris & Mirande 2013), especially in North America, Europe and Asia (Takekawa and Orthmayer 2001). However, there is only limited information about the ecology of Wattled Cranes in Ethiopia. Past studies on their distribution include those by Konrad (1981), Urban & Walkinshaw (1967), Beilfuss *et al.* (2000) and Bento *et al.* (2007), with a population survey by Motsumi *et al.* (2007). Meanwhile, Davenport and Urban (2010) reported on the activity patterns of captive individuals, and Jones *et al.* (2006) carried out molecular studies in southern and south-central Africa. In addition, studies on time budgets have been published for cranes in North America (Tacha 1988) and Europe (Alonso & Alonso 1993); however, there remains very limited past information on the activity pattern of wild populations of Wattled Cranes in Africa. Such information has immense importance for quantifying how Wattled Cranes apportion their time to cope with varying energy demands, how they cope with various environmental changes on a daily, seasonal, and a year-to-year basis, and how these birds use different habitat types (Maxson & Pace, 2016).

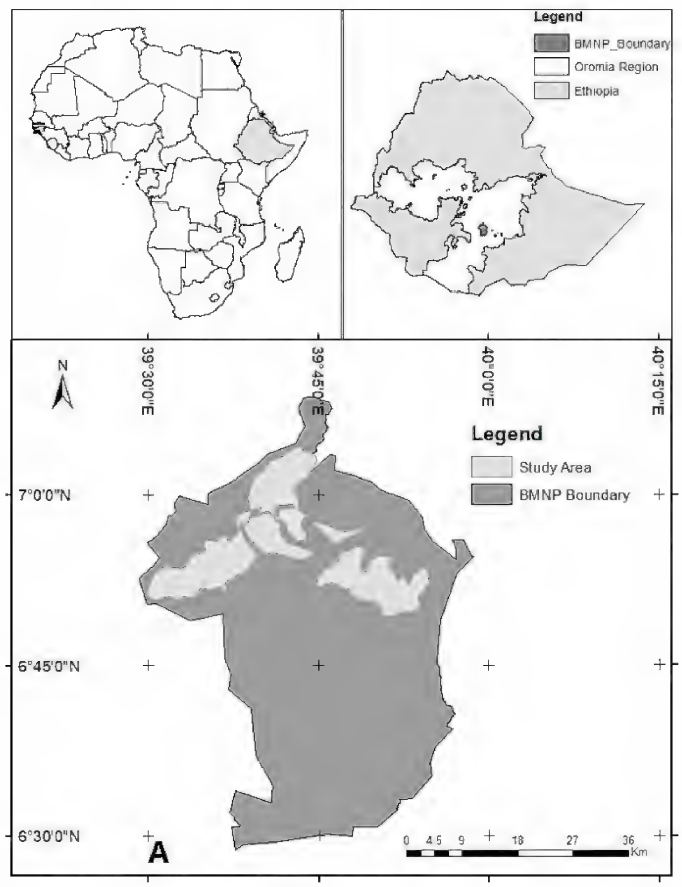
The application and implementation of conservation measures towards a species or the habitat on which it depends, requires a detailed understanding of that species ecology and life history strategies, including how the species interacts with its environment (Liu *et al.* 2010). In addition to the importance of the ecological studies for species-level conservation planning, the availability of such information on Wattled Cranes will have other benefits such as serving as baseline data for subsequent biological and ecological studies on the species. Therefore, this study is aimed at determining the time budget and diurnal rhythm of behaviour of Wattled Cranes both seasonally and across different habitats of the Boyo Wetland and Bale Mountains National Park.

Materials and methods

Study sites

This study was carried out in Boyo Wetland (BW) and Bale Mountains National Park (BMNP), which support the Ethiopian Wattled Crane population's main wintering and breeding habitats in Ethiopia, respectively. BW is situated in the central Rift Valley area of Ethiopia, located between 7°29′ N and 38°03′ E (Fig. 1a) in the South Nations Nationalities and Peoples Region, 300 km southwest of Addis Ababa. The altitude ranges from 1850 to 1900 m asl. The wetland is a freshwater lake and swamp (Delelegn 1998). During the peak wet season of August and September, the water level rises and the whole area of the wetland becomes flooded, whilst during the dry season the water level recedes and changes to a vast area of grassland, which local communities use for uncontrolled/unregulated grazing. The wetland is part of the Bilate River basin that drains from the Gurage Highlands south into Lake Abaya (EWNHS 1996). The wetland has two main inflows or tributaries: the Weira River from southern highland areas, and the Guder River from the Western mountains. Near the regional capital, Hosaena, the two merges to form BW before draining to join the Bilate River in the eastern part of the wetland.

The BMNP, which is located in the southeastern part of the Ethiopian plateau, is part of Conservation International's Eastern Afromontane Biodiversity Hotspot Area (Williams *et al.* 2004). It is also Conservation International's 34th Biodiversity hotspot (Williams *et al.* 2005) and may also be nominated for World Heritage Site listing for its rich biodiversity and the wide ecological services it provides, both nationally and regionally (OARDB 2007). It is located 400 km southeast of Addis Ababa and 245 km east of BW. The Park belongs to the Bale-Arsi massif, which forms the western section of the southeastern Ethiopian highlands (OARDB 2007). It encompasses 2150 km^2 of mountains and forest and lies between the geographical coordinates of 6°29′ to 7°10′ N and 39°28′ to 39°57′ E (Fig. 1b). It is one of the most intact remnants of Ethiopia's indigenous forests (Marino 2003). It covers an altitudinal range of 1500 to 4377 m at Tullu Deemtu, which is the second highest peak in Ethiopia (Hillman 1986, EWNHS 1996, Fishpool & Evans 2001). The Park possesses the largest extent of Afroalpine habitats (above 3000 m asl) in Africa, which is where Wattled Cranes breed (Marino 2003, Ash & Atkins 2009). In the Afroalpine habitat of the National Park, Wattled Cranes favour areas with extensive wetlands and lakes with islands, located at an altitude of 3502 to 4034 m (Tadele 2018).



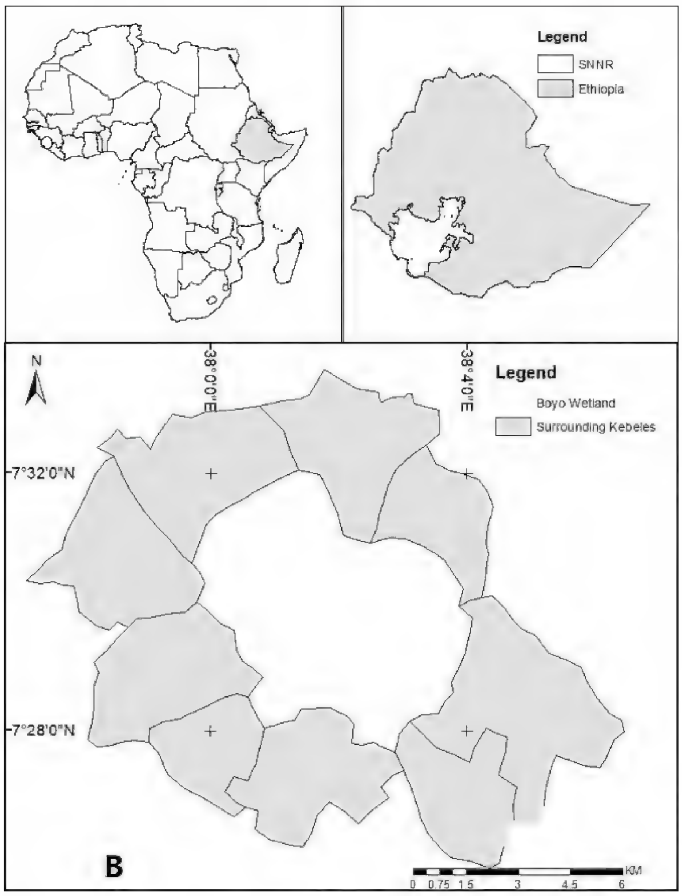


Figure 1. Map of the study areas (a) Bale Mountains National Park and (b) Boyo Wetland.

Methods

To determine the diurnal time-activity budget of Wattled Cranes at BW, four habitat types were recognized: 1) agricultural land (farmland for subsistence crops), 2) grassy field, 3) mudflat, and 4) shallow wetland. In the breeding habitat at BMNP, two different habitat types were identified based on the availability of vegetation and water, and using cues such as the level of small mammal activity in the surrounding areas. Based on this, habitats were classified as grasslands when the availability of grassy area was high (>50 % grass cover) and as swampy area (alpine wetland dominated by emergent grasses and other herbaceous plants), following a methodology similar to Aborn (2010). Behavioural observations and habitat use data were collected from October to June 2015/2016 and 2016/2017 in BW and from June to November 2014/2017 in the Afroalpine habitats of BMNP. Observations were made between 06:00 and 18:00. To assess the influence of the time of the day on behavioural activities, days were divided into three 4-h blocks from sunrise to sunset: morning (06:00–10:00), midday (10:01–14:00) and afternoon (14:01–18:00) following Aborn (2010). Similarly, to assess habitat preferences for Wattled Cranes, we recorded habitat type for each flock seen, and number of individuals in the flock. Observations were reasonably well balanced across time periods, among habitats and between

seasons, enabling variations in activities and their relationship to variables to be assessed. A flock was considered as those consisting of more than two individuals occurring within 10 m from one another (Wang *et al.* 2011).

During data collection, once flocks were found, instantaneous scan sampling was carried out (Altmann 1974, Sutherland 2004), to record the daily activity time budget of the species through scanning each individual in turn and categorizing its behaviour into different behavioural states. Individuals from a flock in visible fields were scanned for five minutes, during which instantaneous behaviour was recorded at 15-second intervals (20 observations per focal bird) (Weins *et al.* 1970, Zhou *et al.* 2010). Focal individuals flying outside the observation area were assumed to be in flight for the balance of the 5-minute period and observations were resumed at the start of the next period from the location where the bird took flight. Similar methods have been used for different crane species including Siberian Crane *Leucogeranus leucogeranus* (Jia *et al.* 2013), Sandhill Crane *Grus canadensis* (Tacha 1988), Common Crane *Grus grus* (Alonso & Alonso 1993, Avilés & Bednekoff 2007), Black-necked Crane *Grus nigricollis* (Kong *et al.* 2008), as well as captive Wattled Cranes (Davenport & Urban, 2010). However, birds were not sexed due to their similar morphology, and observations were restricted to adult birds because the number of juveniles in the wintering habitat at BW was too low to collect a sufficient amount of data for analysis. In this study, six behavioural states were distinguished.

1. Foraging (a crane picking, digging, or drinking (Wang *et al.* 2011) and searching for food while walking with lowered head (Zhou *et al.* 2010)).
2. Resting (a crane pausing or sleeping),
3. Comfort movement (cleaning or preening as well as muscle stretching comfort movement, locomotion, vigilance and social interaction).
4. Vigilance or alert (scanning its area by erecting its head upward (Tacha 1988).
5. Locomotion (walking while raising the head, running, flight and flapping).
6. Social interaction (behaviours of intraspecific interactions such as dancing and agonistic behaviours).

Data analysis

The behavioural data were initially checked with the Shapiro-Wilk test, to test if the data fitted a normal distribution or not. If the data fitted normal distribution, a parametric tests such as a one-way ANOVA (e.g., activity among habitats, flock size among habitats) was used for the time budget and the variation across different habitats and between seasons. On the contrary, if data were not normally distributed, log transformation (log 10) was applied to the raw data to comply with normality. If this yielded similar results, we reported the results based on raw data then applied only non-parametric tests such as the Mann-Whitney U test (e.g., activity between seasons and flock between seasons).

For the statistical analysis of focal observations, the percentage of occurrences among different behaviours, as well as time periods, was reported. The frequency of the different behaviours was also tallied, and a Student's T-test and ANOVA were used to determine any statistical variation in the frequency of behaviours in relation to habitat types, time periods of a day and seasonal variations. Chi-square test and

Pearson correlation analyses were conducted to examine associations and relationships between behaviours and flock size. All the above analyses were undertaken using SPSS version 20.

Results

During the whole study period both in BW and BMNP a total of 452 focal observations representing 2260 min or 37.7 hrs were gathered. A total of 134 (29.6 %) focal observations were conducted in agricultural fields whereas 102 (22.6 %), 105 (23.2) and 111 (24.6) focal observations were made on the mudflat, grassland, and shallow wetland habitats respectively.

Compared to other activities, Wattled Cranes spent more time (39.3 %) foraging with a mean frequency of 7.74 (± 0.59) per 5 min. While on locomotion, they spent 20 % of their time either looking for food or making other types of movements. The least amount of time was spent on social behaviour, which accounted for 2 %, while the rest of their time was allocated for resting and comfort movement (Table 1).

Table 1. Activity-time budget of Wattled Cranes over 37.7 hours of observation time across all habitat types.

Activity	Total activities recorded	Percentage (%)	Mean/5 min ± SE
Foraging	3,500	39.3	7.74 ± 0.59
Locomotion	1,775	20	3.93 ± 0.04
Vigilance	1,378	16	3.05 ± 0.35
Comfort movement	1,289	15	2.85 ± 0.49
Resting	824	9.3	1.82 ± 0.40
Social behaviour	134	2	0.3 ± 0.11

In the agricultural and grassland habitats, more of the daily activity budget was made up of foraging or locomotion compared to foraging in the mudflat and shallow wetland habitats where they devoted more time to vigilance, resting and comfort movement, as they gathered to drink or roost (Table 2). When considering each activity in relation to the four different habitat types, there was a significant variation in frequency of foraging activity ($\chi^2_{(3)}=35.728$, $p<0.05$), resting ($\chi^2_{(3)}=39.682$, $p<0.05$), comfort movement ($\chi^2_{(3)}=56.287$, $p<0.05$), vigilance ($\chi^2_{(3)}=12.108$, $p<0.05$) and locomotion ($\chi^2_{(3)}=43.400$, $p<0.05$), of Wattled Cranes among the four habitat types. However, there was no significant variation in the activity level of social behaviour ($\chi^2_{(3)}=6.157$, $p>0.05$), across the different habitat types.

Table 2. Activity-time budget of Wattled Cranes across four habitat types expressed as the mean number of activities per 5 min ± SE.

	Habitat type			
Activity	Agricultural area (n= 134)	Shallow wetland (n=105)	Grassland (n= 111)	Mudflat (n= 102)
Foraging	9.97 ± 0.86	5.40 ± 1.16	8.44 ± 1.26	6.66 ± 1.34
Locomotion	5.51 ± 0.76	2.65 ± 0.77	4.10 ± 0.89	3.05 ± 0.77
Vigilance	3.14 ± 0.76	3.76 ± 0.95	2.03 ± 0.48	3.21 ± 0.82
Comfort movement	0.49 ± 0.52	4.83 ± 1.09	2.75 ± 1.02	3.90 ± 1.23
Resting	0.69 ± 1.23	2.72 ± 0.77	2.21 ± 1.00	1.94 ± 0.91
Social behaviour	0.13 ± 0.13	0.53 ± 0.28	0.34 ± 0.30	0.21 ± 0.19

Time spent for foraging ($\chi^2_{(2)}=40.037$, $p<0.05$), resting ($\chi^2_{(2)}=52.483$, $p<0.05$), comfort movement ($\chi^2_{(2)}=30.866$, $p<0.05$), vigilance ($\chi^2_{(2)}=23.180$, $p<0.05$) and locomotion activity ($\chi^2_{(2)}=24.489$, $p<0.05$) varied significantly across the time of the day or showed a pattern within a day. Foraging activity most often peaked in the morning and least often during the afternoon. In comparison, resting and comfort behaviours were more frequent during the afternoon than the morning and midday. Vigilance behaviour peaked in the morning then decreased in the midday and finally reached its lowest level in the afternoon. However, movement activity was significantly higher in the morning than during midday and afternoon. The time spent preening increased as birds come to roost and aggregate together for overnight roosting and also during midday when they returned for drinking and midday roosting (taking some time to rest during the midday; Fig. 2).

With regard to time spent on social behaviour, the variation was not significant across daily time periods ($\chi^2_{(2)}=4.778$, $p=0.092$), where the frequency of time spent on social behaviour was higher during the afternoon than during morning or midday.

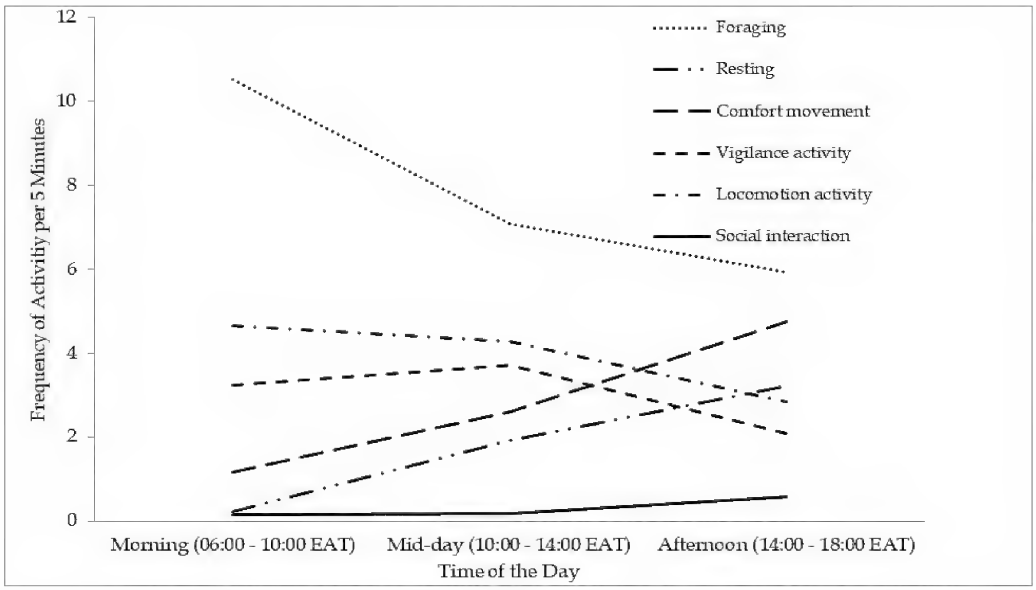


Figure 2. Frequency of different behaviour types per 5-minute intervals across three time periods.

Seasonally, foraging behaviour varied significantly ($U=22{,}325$, $p<0.05$), being more prevalent during the wet season (mean 8.42 ± 0.83) than the dry season (mean 7.16 ± 0.83) per five-minute focal observation. In addition, the observed frequency of vigilance behaviour was significantly greater in the wet season (3.83 ± 0.58) than the dry season (2.38 ± 0.40, $U=19{,}797$, $p<0.05$) and the same is true for comfort movement ($U=22{,}702$, $p<0.05$) and resting ($U=22{,}857$, $p<0.05$), where the percentage of time spent moving and resting was higher during the dry season than during the wet season (Fig. 3).

A total of 452 flocks were observed during the study period and the mean flock size was 4.67 (±0.44 SE) with range 2 to 29. A significant difference in flock size was observed among the habitat types at BW ($\chi^2_{(3)}=13.1$, $p<0.05$), where flock size in the shallow water or wetland habitat was larger (6.49 ± 0.41) than in the other habitat types.

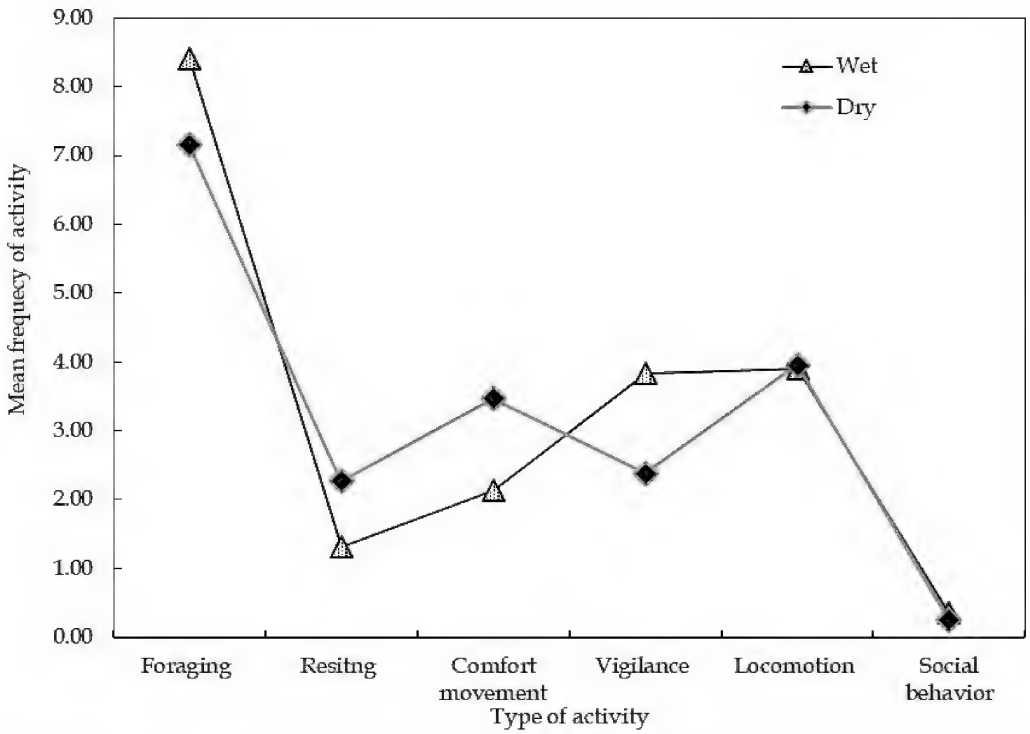


Figure 3. Mean frequency of different activity types of Wattled Cranes during different seasons.

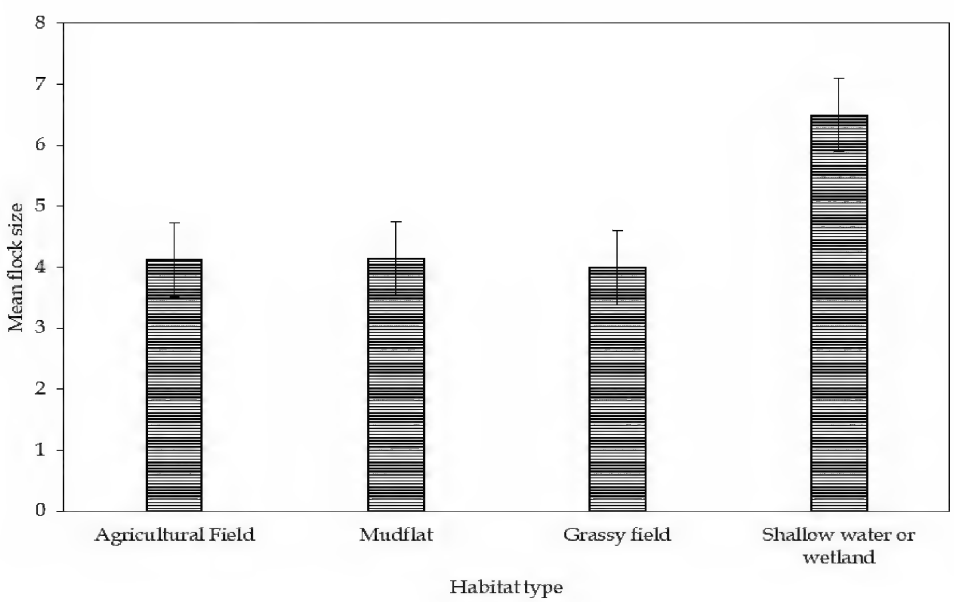


Figure 4. Variation in flock size of Wattled Cranes across the four Boyo habitat types.

In addition, flock size was also significantly different ($\chi^2_{(2)}=6.55$, $p<0.05$), across the three-time categories of the day, where the mean flock size in the afternoon (6.44 ± 1.15), range 2 to 29 was much greater than the midday (3.42 ± 1.22), range 2 to 24 and the morning (2.04 ± 0.343), range 2 to 11.

There was also significant variation in flock size between the dry and wet seasons ($U=32{,}377$, $p<0.05$), whereby the mean flock size during the dry season was larger (5.67 ± 0.713) than the wet season (3.14 ± 0.425). As flock size increased time spent on vigilance decreased ($r^2=-0.145$, $p<0.05$). In addition, flock size was negatively correlated with foraging, ($r^2=-0.232$, $p<0.05$) as well as locomotion ($r^2=-0.147$, $p<0.05$). However, flock size was positively correlated with comfort movement ($r^2=0.223$, $p<0.05$) and social behaviour ($r^2=0.295$, $p<0.05$).

Discussion and conclusions

Birds diurnal time activity budget may vary significantly between breeding and wintering seasons (Turner 1982), as a strategy to cope with environmental factors such as differing habitat types, food abundance and climate (Yang *et al.* 2007). During the study period, Wattled Cranes spent more time foraging (39.3 %) and this was significantly affected by habitat type, time of the day, and season. Similarly, Konrad (1981) reported that procurement of food takes up the greater part of the day for wild Wattled Cranes in Africa. By contrast, Wattled Cranes in captivity spent only 25 % of their time budget on foraging compared with wild birds (Davenport & Urban 2010). In captivity, animals are provided with food resulting in decreased time spent on searching for food. Similar to Wattled Cranes, other wetland birds such as Siberian Crane (Jia *et al.* 2013), Hooded Cranes (Zhou *et al.* 2010) and Canvasback *Aythya valisineria* (Hohman & Rave 1990) spend more energy searching for food or foraging than on other activity types.

Wattled Cranes spent more time feeding in agricultural habitat than in the other three habitat types in BW, even though this species is considered as the most wetland-dependent of Africa's cranes (Konrad 1981). This might be due to the abundant food resources or waste grains in maize and wheat fields combined with the scarcity of food in wetlands due to habitat degradation caused by heavy siltation from the surrounding watershed (Deboch, 2018). Similarly, Black-necked Cranes have been forced to choose new habitats of traditionally cultivated fields with abundant potato residues compared to wetland habitats, which were degraded due to increased human disturbance in Huize Nature Reserve, Yunnan, China (Wu *et al.* 2013).

The activity budgets of Wattled Cranes differed significantly between diurnal time periods, where locomotion and foraging were more frequent in the morning than during midday and afternoon. Since feeding is directly related to energy procurement, diurnal distribution should reflect patterns of an individual's diurnal energy demands, given constant food availability. Therefore, the morning feeding peak probably occurred because Wattled Cranes had not fed for 11–12 h and they had to feed in the early morning to make up the energy debt incurred during the night, similar to wintering Common Cranes in Gallocanta, Spain (Alonso & Alonso 1992). Time spent being vigilant was higher during the breeding season than the dry season, due to their occurrence in pairs/small flocks during the breeding season compared to large flocks during the dry season. The reason behind the negative correlation between flock size and vigilance might be that as the number of individuals in a group

increased, the time allocated to scanning for danger decreased as this responsibility is shared among more individuals; this is termed a 'many eye hypothesis' (Roberts, 1996). Similar results were also observed in Black-necked Cranes (Yang *et al.* 2007), Common Cranes (Avilés & Bednekoff 2007), Red-crowned Cranes *Grus japonensis* (Wang *et al.* 2011) and other vertebrate animals like Columbian Ground Squirrels *Urocitellus columbianus* (Fairbanks & Dobson 2007). Contrary to this, when group size increases, the level of foraging competition also increases (Roberts 1996).

Time spent being vigilant by Wattled Cranes (15.5 %) was much less pronounced than in Red Crowned Cranes (23.6 %) in Shengjin Lake (Wang *et al.* 2011) and Hooded Cranes *Grus monacha* (24.8 %) in Yancheng Biosphere Reserve, China (Li *et al.* 2015). This might be due to the fact that Wattled Cranes in BW are well adapted to human disturbance as there is no culture of killing or shooting by the local people.

Wattled Cranes spent more time foraging during the wet season in BMNP than in the dry season in BW. This is likely due to the high energy demand during the breeding season or the scarcity of available food in the Afroalpine habitat, forcing cranes to search for food for a longer time. Similar results were obtained by Hohman & Rave (1990), where the difference in time allocation for foraging between sites was due to characteristics of the food, mode of foraging, disturbance level and characteristics of the habitat for Canvasbacks. In addition, energy demands of birds at high altitude such as BMNP is high compared to those in lowland areas because of the high basal metabolism rate due to lower temperatures leading to elevated thermoregulatory costs (Londoño *et al.* 2015). Another theory is that foraging time differs because foraging strategies differ between areas and between seasons. During the breeding season or at the breeding area, Wattled Cranes feed mostly on tubers or soft roots of grasses, which they dig up and it is time consuming elevating the foraging time. Whereas, during the dry season, Wattled Cranes mostly feed on farmlands, gleaning waste grains from the fields.

Flock size showed significant variation both among the habitat types and across the three daily time periods, where larger flock size was observed in the shallow wetland habitat and during the afternoon. This might be due to large flock formation at the shallow wetland during the midday for roosting and drinking as well as during the afternoon for night roosting. Cranes typically roost on the ground or while standing in shallow water to protect themselves from danger (Johnsgard 1983).

Data analysis was restricted to adult birds because the number of juveniles at BW or the wintering habitat was low and it was not possible to collect enough data on juveniles. However, juvenile cranes tend to be less vigilant, as in Sandhill Cranes (Tacha 1988) and Common Cranes (Alonso & Alonso 1993, Avilés & Bednekoff 2007), and are known to devote more time to feeding than to vigilance. Adult Common Cranes with juveniles seem to scan their area more frequently (Avilés 2003).

Overall, the results of this study show that wintering Wattled Cranes in BW exhibit different behavioural patterns in different habitat types, seasons, and times of day. This allows them to adapt to the changing environment and other biotic and abiotic factors. Contrary to Wattled Cranes' known behaviour as one of the most wetland-dependent species of all African cranes (Meine and Archibald, 1996), the results show that they spend more time in farmland than in wetland habitats, especially for foraging. This suggests that the natural foods of this vulnerable species, predominantly *Eriocholoa fatmensis* and *Eriocholoa meyeriana* grasses, are decreasing due the degradation of the size of the wetland (Tadele 2018). However, spending

more time in farmland may create a conflict with farmers around the wetland, which could expose them to more threats. Urgent measures should therefore be undertaken to restore wetland habitats and enhance the growth of natural food sources for the Wattled Crane.

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Short communications

The rediscovery of the *colomanni* von Madarász subspecies of the Grey Penduline-tit *Anthroscopus caroli*

On 25 August 1909 a specimen of Grey Penduline-tit *Anthoscopus caroli* was collected on the Ngare Dowash (the Mara River in modern-day northern Tanzania) by Kálmán (Koloman) Kittenberger, and was subsequently described as a new subspecies, named *colomanni* (von Madarász 1910: 177). It was described as being 'grey on the upper parts; forehead, cheeks and throat cloudy white, the latter washed down to a yellowish cream colour, gradually becoming pale yellowish-brown on the lower under parts; wings and tail grey-brown; under wing white with slight rusty colour; wing 57 mm'. Twenty years passed before mention of *colomanni* appeared in the literature again, when Sclater (1930) reported that *colomanni* 'appears to be indistinguishable from *A. c. sylviella*', and subsumed it into the latter taxon. Subsequently, the type specimen, housed in the Budapest Natural History Museum, was destroyed by fire during the Soviet invasion there in 1956 before further study was possible (Horváth 1970). To this day, only Sclater (1930) has commented on the form, the description of the type has been almost universally forgotten, and no observers have reported or knowingly identified *colomanni* in the field since its initial collection together with a description of its nest (Kittenberger 1959). The nest itself was photographed (von Madarász 1910), this now comprising the sole extant "evidence" of the type.

However, a photograph of an adult Penduline-tit taken by Mr. B. Hofstetter on 12 June 2019 along the Mbalagati River in the southern part of Serengeti National Park, Tanzania (02°37′24″ S 34°44′23″ E), appears to match the description of *A. c. colomanni* exactly, and is provisionally regarded as representing the taxon here (Fig. 1). Contrary to Sclater (1930), who felt *colomanni* to be indistinguishable from *sylviella*, it differs by way of a complete absence of rusty-clay tones below, the cream-yellow wash on the throat grades to pale yellow-brown lower underparts, with cheeks and forehead white. Further evident are very pale grey upperparts. In *A. c. sylviella* (and *A. c. sharpei*), by contrast, the underparts (breast to vent) are consistently a rich rusty-clay to tawny-cinnamon, with the throat, cheeks and forehead slightly paler, if differing in tone at all (Fry *et al.* 2000), while the upperparts are a darker grey, faintly washed olive. Photographs of the type specimen of *sylviella* alongside a more recent specimen of the similar *A. c. sharpei* from the Tabora region, confirm these differences (Fig. 2).

Figure 1. Image of the largely unknown taxon *Anthoscopus caroli colomanni* from the Mbalagati drainage, Serengeti National Park, Tanzania, 12 June 2019, showing the characteristic whitish forehead and cheeks, with cream-yellow throat grading into pale yellow-brown lower underparts (Macaulay Library #169436451: B. Hofstetter).

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Figure 2. Field and specimen images of *Anthoscopus caroli sylviella* (A–B) and *A. c. sharpei* (C–D) from Tanzania showing typical, near-uniform rusty-clay to tawny underparts. A: Ruaha National Park (R. Glen); B: Malangali (ZMB 48/68; holotype of *sylviella*); C: Maswa Game Reserve (P. Oliver); D: Tabora area (UWBM 95720 (MBM 5909)). For acronyms, see Acknowledgements.

That such a distinctive taxon, described more than 100 years ago, appears to have been overlooked in such a well-visited area as the Serengeti National Park may seem unlikely. However, a putative but plausible explanation concerns the specific locations from where the recent photograph was obtained and the type specimen collected. In both cases the locations are riverine, and more specifically, in notably arid sections of mid-river drainages. In the case of the type locality, the Ngare Dowash in northern Tanzania, this section of the Mara River is locally arid, being distant from the high-rainfall areas at its source in the Mau Highlands, as well as from the high-humidity region at the river's outflow into Lake Victoria. The difference in habitat between this middle section of the Mara River, and the moister surrounding savannah occupied by *A. c. sylviella*, may be inferred from satellite imagery (Fig. 3) and the description of the nest site by Kittenberger (1959: 70). A similar, but less stark difference in aridity, is also evident on the middle Mbalagati River, where the recent observation of *A. c. colomanni* was made.

Figure 3. Satellite imagery of the middle Mara River (Ngare Dowash) in northern Tanzania, showing the steep aridity gradient from the river to surrounding plains (map source: Google Earth).

In this light, the possibility that *colomanni* persists as a distinct form closely tied to locally arid riverine habitats, and therefore ecologically separated from *A. c. sylviella/sharpei* (of moister plains-*Acacia* associations), should be investigated further. Reflecting on another form of *A. caroli*, extralimital to the East Africa region, some comparisons with subspecies *rankinei* are also appropriate. This taxon is known from specimens collected in *Acacia* woodland along an arid section of the middle Zambezi River in northern Zimbabwe (Irwin 1963). Like *colomanni*, *rankinei* is characterised by nearly all-white underparts, cheeks and forehead, albeit with very dark slate-grey vs. pale grey upperparts. As appears to be the case with *colomanni*, which is known from two sites within a broader region inhabited by another subspecies (*sylviella*), *rankinei* also persists in a very small range with particular habitat isolated among the ranges of other subspecies (*caroli*, *hellmayri* and *robertsi*).

Even in light of the limited material presented here, we believe the name *colomanni* was validly established, and that this taxon should be resurrected from synonymy. Field workers should be alert to the presence of birds matching the description of *colomanni* in Serengeti National Park, in particular when sampling arid riverine habitats.

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Observations of birds foraging on Desert Locusts *Schistocerca gregaria* in the Afroalpine ecosystem of Bale Mountains National Park, southeast Ethiopia

The Desert Locust *Schistocerca gregaria* has been considered a major pest and cause of famines across the arid regions of southwest Asia, the Middle East and northern Africa. Swarms originating from the Red Sea coastal plains of Eritrea and Sudan, and also from northern Somalia, have historically threatened lowland agricultural regions of Ethiopia, with the highland regions of the country being affected to a lesser extent (Fashing *et al.* 2010, FAO 2010). Unlike this previously observed trend, however, recent reports show the persistence of sexually immature adult individuals and swarms of Desert Locusts in the southeastern Ethiopian highlands (FAO 2020, 2021), encompassing the Bale, Arsi and Harar Mountains.

During fieldwork in the Bale Mountains in 2020/2021, we made opportunistic observations of birds feeding on Desert Locusts. Here, we detail the occurrence of Desert Locusts in the Afroalpine ecosystem of the Bale Mountains during this period, and provide list of bird species observed feeding on locusts, along with brief notes on their foraging strategies and flocking behaviours. Taxonomy, dietary requirements and occurrence follow BirdLife International (2021).

Study area and methods

We made our observations in Bale Mountains National Park (hereafter BMNP), which is the most important representation of the Ethiopian Highlands biome within Conservation International's Eastern Afromontane Hotspot biodiversity area (Williams *et al.* 2004). The park is currently temporarily listed as a UNESCO World Heritage Site. It is situated 400 km southeast of Addis Ababa in southeastern Ethiopia and covers a 2200 km^2 area. Elevation within the park ranges from 1500 to 4377 m and the park encompasses the largest area of Afroalpine habitat above 3000 m in Africa (BMNP 2017).

Our observation data comes from eight localities, covering four of the five broad vegetation types in the park: Sodota (5°13′09″ N, 41°27′41″ E), Sanatti (5°23′45″ N, 41°19′23″ E), Gayssay (5°15′52″ N, 41°34′ 49″ E), Dinsho Hill (5°18′22″ N, 41°33′52″ E), Gurratti (4°,59′,08″ N, 41°,21′,09″ E), Rafu (6°51′17″ N, 39°44′09″ E), Genalle (6°57′17″ N, 39°38′58″ E) and Morebawa (6°54′13″ N, 39°35′42″ E). Five of these localities are situated in Afroalpine ecosystems at altitudes of 3600 to 4200 m, while the three remaining localities were in the northern montane grasslands (Gayssay Valley; 3000 m), dry Afromontane forest (Dinsho Hill; 3150 m), and the ericaceous scrubland (Gurrati; 3700 m). All observations at localities in the Afroalpine habitat were made between January and March 2021, except at Sodota and Sanatti, which were surveyed in January and February 2020, respectively. Observations were made for a total of 12 days: for three days at Gurrati, two days each at Sodota and Dinsho Hill, and a day each at the other sites.

Field observations and discussion

We first observed the appearance of Desert Locusts at BMNP at Sodota Wolf Camp on 23 January 2020 when a large swarm consisting of millions of individuals moving eastwards invaded the area, reaching the Sannati Plateau by 8 February 2020. For the

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remainder of the study period, we frequently encountered swarms, small groups and solitary locusts throughout BMNP. To our knowledge, the maximum elevation recorded for the Desert Locust in Ethiopia is 3500 m at Guassa Plateau in the central highlands of Ethiopia in June 2009 (Fashing *et al.* 2010). Thus, our observation at over 4200 m at several of our study localities (e.g., Sanatti and Rafu) comprises a new altitudinal record for the Desert Locust. The locusts were verified as Desert Locusts based on their size, colour, and presence of a tubercle between the head and thorax (Symmons & Cressman 2001).

During their appearances, locusts were mostly airborne but also sometimes landed on the ground in large numbers where birds were observed chasing, capturing, and eating them. Overall, we observed 37 species of birds feeding on desert locusts in BMNP during the years 2020 and 2021 (Appendix A). This comprised: (i) 27 (73 %) resident, including five endemic or near endemic, species, (ii) ten migratory species, and (iii) five globally threatened species, including the vulnerable Tawny Eagle *Aquila rapax* and Eastern Imperial Eagle *Aquila heliaca*, and the near-threatened Rouget's Rail *Rougetius rougetii*, Pallid Harrier *Circus macrourus* and Abyssinian Longclaw *Macronyx flavicollis* (BirdLife International 2021; Appendix A). Although previous reports (e.g., Bocheński & Jerzak 2006, Sanchez-Zapata *et al.* 2007, Fashing *et al.* 2010) show that a wide variety of bird species may prey upon Desert Locusts, our observations comprise the first records of foraging on locusts for 12 species: Wattled Ibis *Bostrychia carunculata*, Rouget's Rail, Alpine Chat *Cercomela sordida*, Rüppell's Robin-chat *Cossypha semirufa*, Mountain Thrush *Turdus plebejus*, Ethiopian Thrush *Psophocichla simensis*, Abyssinian Ground Thrush *Zoothera piagiae*, Red-breasted Wheatear *Oenathe bottae*, Thekla's Lark *Galerida malabarica*, Abyssinian Longclaw, Abyssinian Slaty Flycatcher *Melaenornis chocolatina* and Red-billed Chough *Pyrrhocorax pyrrhocorax*. We noted two major types of foraging strategies used by the birds: aerial and ground. Most raptors, crows and ravens were feeding on airborne locusts by circling them from above, while other species foraged on the ground, capturing locusts either by leaping into the air and grabbing low flying locusts, or by pouncing on those that had already landed (Appendix A). Twenty-two (60 % of the total species) species observed foraging on locusts were obligate insectivores, with ten and five species being carnivores and omnivores, respectively (Appendix A; for species-specific dietary requirements, see BirdLife International 2021). At BMNP, bird species recognized as carnivorous are known to forage on the abundant rodents there (Clouet *et al.* 2000). Our observations suggest that large quantities of easily accessible protein available in locust swarms (Sanchez-Zapata *et al.* 2007) are enough to stimulate some species to temporarily shift to intensive opportunistic feeding on insects. Elsewhere, predatory bird species are known to be significant as a mortality factor affecting the population size and breeding success of Desert Locusts (Mullié *et al.* 2021).

We also noted that for some species, they occurred in larger flocks while feeding on locusts than is their typical flock size at BMNP. For example, we observed Yellow-billed Kite (typically 2 individuals vs observed >40 individuals in our study), Thick-billed Raven (3 vs >20), Tawny Eagle (2 vs >10), Red-billed Chough (7 vs 18), Fan-tailed Raven (3 vs 8), and White Stork (10 vs >1000) in unusually large flock sizes. Our regular observation of flocks constituting thousands of White Storks at each of Gayssay grassland, Dinsho Hill woodland forest and Gurrati localities is particularly noteworthy (Fig. 1). White storks are migratory birds that use the Bale Mountains as a stop-over on their way southward in Africa (BirdLife International 2021).

They are known to feed on Desert Locusts on their wintering grounds, such as in the Sahel zone, and sometimes follow such swarms during their migration (Bocheński & Jerzak 2006). However, we have never encountered such large-sized flocks at BMNP during 20 years of observations in the park.

Figure 1. Part of a large flock of White Storks following locusts at Gurrati, Bale Mountains National Park, on 21 February 2021 (photo: S. Wondimu).

Locusts play an important role within the food web structure in natural ecosystems through food competition with herbivores, and by providing a food source for predators (Sanchez-Zapata *et al.* 2007, Fashing *et al.* 2010). Many bird taxa, including numerous raptors, storks and passerines, have long been known to prey on locusts, and sometimes migratory birds may follow desert locust swarms specifically (Sanchez-Zapata *et al.* 2007, Mullié *et al.* 2021). Our findings also highlight the vital ecosystem services provided by birds in pest control and the need to consider this role in developing biological locust pest control strategies. In conclusion, our observations have provided new information on birds that feed on Desert Locusts at the highest elevations they are known to occur. While these findings are consistent with the predicted invasion of highlands by locusts associated with global warming, continued monitoring is necessary to determine whether this trend will continue at BMNP.

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Appendix A. List of bird species observed feeding on Desert Locust at eight localities in the BMNP in 2020 and 2021, detailing species-specific foraging strategies (on the ground, aerial or both) and primary dietary requirement (Carn. = Carnivore; Ins. = Insectivore, and Omni. = Omnivore). Superscript letters following English names indicate whether a species is endemic or near endemic (a), resident (b) or migrant (c)]. Taxonomy, dietary requirement and occurrence follow BirdLife International (2021).

English name	Scientific name	Locality	Foraging strategies	Diet
Rouget'sRail[a]	*Rougetius rougetii*	Gennale	Ground	Ins.
White Stork[c]	*Ciconia ciconia*	Gurrati, Gayssay, Dinsho Hill	Both	Ins.
Wattled Ibis[a]	*Bostrychia carunculata*	Morebawa	Aerial	Ins.
African Harrier-Hawk[b]	*Polyboroides typus*	Dinsho Hill	Aerial	Carn.
Lesser Spotted Eagle[c]	*Aquila pomarina*	Morebawa	Ground	Carn.
Tawny Eagle[b]	*Aquila rapax*	Gayssay, Dinsho Hill	both	Carn.
Eastern Imperial Eagle[b]	*Aquila heliaca*	Morebawa	Ground	Carn.
Rufous-breasted Sparrowhawk[b]	*Accipiter rufiventris*	Dinsho Hill	Aerial	Carn.

English name	Scientific name	Locality	Foraging strategies	Diet
African Goshawk[b]	*Accipiter tachiro*	Dinsho Hill	Aerial	Carn.
Western Marsh Harrier[c]	*Circus aeruginosus*	Morebawa	Aerial	Carn.
Pallid Harrier[c]	*Circus macrourus*	Sodota, Rafu, Morebawa, Gayssay	Aerial	Ins.
Yellow-billed Kite[b]	*Milvus aegyptius*	Sodota, Gayssay, Dinsho Hill	Aerial	Carn.
Augur Buzzard[b]	*Buteo rufofuscus*	Morebawa	Aerial	Carn.
Lesser Kestrel[c]	*Falco naumanni*	Rafu; Morebawa, Gayssay	Aerial	Ins.
Common Kestrel[b]	*Falco tinnunculus*	Rafu	Aerial	Ins.
Peregrine Falcon[b]	*Falco peregrinus*	Sodota, Rafu, Morebawa, Gayssay	Aerial	Carn.
Ethiopian Boubou[b]	*Lanius aethiopicus*	Dinsho Hill	Aerial	Ins.
Red-billed Chough[a]	*Pyrrhocorax pyrrhocorax*	Gennale, Morebawa	Both	Ins.
Common Fiscal[b]	*Lanius collaris*	Gayssay, Dinsho Hill	Aerial	Ins.
Cape Crow[b]	*Corvus capensis*	Gayssay	Aerial	Omni.
Pied Crow[b]	*Corvus albus*	Gayssay	Aerial	Omni.
Somali Crow[b]	*Corvus edithae*	Rafu	Aerial	Omni.
Fan-tailed Raven[b]	*Corvus rhipidurus*	Sodota, Sanatti, Rafu, Morebawa	Aerial	Omni.
Thick-billed Raven[a]	*Corvus crassirostris*	Sodota, Morebawa, Gayssay, Dinsho Hill	Aerial	Omni.
Thekla's Lark[b]	*Galerida malabarica*	Sanatti, Rafu	Ground	Ins.
Abyssinian Ground Thrush[b]	*Zoothera piagiae*	Dinsho Hill	Ground	Ins.
Ethiopian Thrush[b]	*Psophocichla simensis*	Gayssay, Rafu	Ground	Ins.
Abyssinian Slaty Flycatcher[a]	*Melaenornis chocolatina*	Dinsho Hill	Aerial	Ins.
African Dusky Flycatcher[b]	*Muscica adusta*	Dinsho Hill	Aerial	Ins.
Rüppell's Robin-chat[b]	*Cossypha semirufa*	Dinsho Hill	Ground	Ins.
Common Stonechat[b]	*Saxicola torquata*	Gayssay	Ground	Ins.
Moorland Chat[b]	*Cercomela sordida*	Sodota, Gennale, Sanatti, Rafu, Gayssay, Dinsho Hill	Ground	Ins.
Northern Wheatear[c]	*Oenanthe oenanthe*	Rafu	Ground	Ins
Mountain Thrush[b]	*Turdus plebejus*	Dinsho Hill	Ground	Ins.
Red-breasted Wheatear[c]	*Oenathe bottae*	Rafu	Ground	Ins.
Abyssinian Longclaw[a]	*Macronyx flavicollis*	Rafu	Ground	Ins.
Red-throated Pipit[c]	*Anthus cervinus*	Rafu	Ground	Ins.

Further observations of the Southern Black Tit *Melaniparus niger* and White-winged Black Tit *M. leucomelas* in southern Tanzania, and a note on the Southern Red-billed Hornbill *Tockus rufirostris*

Baker & Baker (2018) clarified the identity of black tits recorded in southeastern Tanzania as Southern Black Tit *Melaniparus niger*, not White-winged Black Tit *M. leucomelas* as had previously been assumed. This assumption had been based on the fact that *M. niger* was not considered to occur in Tanzania by most of the reference books, as explained by Baker & Baker (2018). A further source of confusion was the understanding that *M. niger* and *M. leucomelas* might be conspecific, but it has since been demonstrated that they are distinct species (Johansson *et al.* 2013). Further work has indicated that, while their respective ranges are mostly separate, they do overlap in parts of Zambia and Malawi (Gosler & Clement 2020a, 2020b, Harrap & Quinn 1996). The existence of *M. niger* in southeastern Tanzania was suggested by its presence just south of the Ruvuma River in Mozambique, where it was recorded by Parker (2005) in the Niassa National Reserve.

In general, the two species occupy different habitats, being largely with slightly higher rainfall and altitude in *M. leucomelas*, which also occupies riparian woodlands, and drier and lower altitude in *M. niger* (Baker & Baker 2018, Harrap & Quinn 1996). However, there is clearly some overlap and the use of the term '*miombo*' might not be consistent between observers. Harrap & Quinn (1996) make the point that local distribution and habitat occupancy are influenced by the presence or absence of other tit species. In Tanzania, Baker & Baker (2018) particularly noted the distance (252 km) and difference in altitude (570 m) in the closest pair of records between the two species.

The records of *P. niger* reported by Baker & Baker (2018) included the 27 observations that I made in and adjacent to Selous Game Reserve between 1991 and 1993, and that I submitted (mistakenly as *M. leucomelas*) to the Tanzania Bird Atlas but without more detailed geo-referencing. During 2019 I returned to one of the localities, Kingupira (8°28′16″ S, 38°32′37″ E, 123 m asl), and confirmed that the black tits there are *M. niger* (as assumed by Baker & Baker (2018)) having become familiar with that species in Mozambique during 2014–2016. It should be noted that in 2019 Selous Game Reserve was divided, such that 30 893 km^2 of the west and north were gazetted as Nyerere National Park, while Selous Game Reserve now refers to the remaining 21 916 km^2 in the east (Government of Tanzania 2019). In this paper I refer to the original Selous Game Reserve.

In fact, I recorded *M. niger* 40 times between 1991 and 1993, in all months, but some of these observations were redundant for the purposes of atlas recording. Kingupira is at the approximate geographical centre of 38 of these observations (Table 1). In addition, I observed black tits north of the Rufiji River on two dates, in the area approximately enclosed by Kinyanguru (7°25′01″ S, 38°00′27″ E), Kimeru (7°17′26″ S, 38°06′21″ E), Kidunda Station (7°18′20″ S, 38°19′25″ E, 73 m asl) and the Uhuru Railway line to the southeast.

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Table 1. Observations of Southern Black Tit *Melaniparus niger* in the Kingupira area, Selous Game Reserve. * Coordinates are given at the approximate centre of these localities, + Ngarambe village is at 8°27′ S, 38°37′ E.

Locality	Number of records	Coordinates
Kingupira	13	8°28'S, 38°33'E
Kingupira-Lower Lihangwa River*	3	8°26'S, 38°31'E
Nahimba*	3	8°27'S, 38°33'E
Kingupira-Kilunda*	13	8°31'S, 38°29'E
Namkongo track (north of Lower Lihangwa River)*	3	8°22'S, 38°20'E
South of Ngarambe village*+	1	8°31'S, 38°38'E
South of Kingupira*	2	8°32'S, 38°33'E

Each of these records comprises multiple sightings and it was noted that they were most common between Kimeru and the railway line. Unfortunately, when I returned to Kinyanguru in 2018 I did not get the opportunity to search for them, though the two other *M. niger* records north of the Rufiji River, referred to by Baker & Baker (2018), suggest that this is the species I saw. The vegetation certainly appears to suit *M. niger*. Nonetheless, it would be advisable to confirm identification as the opportunity arises, since this would extend the range of *M. niger* in Selous Game Reserve north to the Ruvu River.

These records are from various types of dry woodland or wooded grassland, dominated by either *Terminalia spinosa* or *Acacia nigrescens*, or mixed dry woodland with baobabs *Adansonia digitata*, on alkaline soils, often with impeded drainage. During 2014–2016 in Niassa National Reserve, Mozambique, I observed *M. niger* usually, but not invariably, frequenting similar habitat. These dry woodlands extend in a band on either side of the Lihangwa and Lower Lukuliro Rivers from the Rufiji River south through Kingupira and Ngarambe to and south of the Matandu River at Kitumbimkwera (8°56′ S, 38°35′ E). South of the Matandu River the appropriate habitat extends as far as the Ruvuma River through Nachingwea and Masasi. To what extent this is continuous I cannot say, but the northern half of the area is still wild and the relatively dense large mammal populations there (TAWIRI 2019) suggest that it may support suitable vegetation on alkaline soils. East of Liwale there are extensive *A. nigrescens* woodlands, which are also a favoured habitat.

Baker & Baker (2018) also noted a distribution gap in recorded observations between *M. niger* in the low dry country to the southeast, and *M. leucomelas* in the hills to the northwest. Therefore, it is of interest that on 8 November 2015, while walking the Mozambique bank of the Ruvuma River at the Mapanda Hills (11°18′ S, 37°51′ E, 272 m asl) in the Niassa National Reserve, I observed a party of two *M. leucomelas* cross from the Tanzanian bank. Excellent views of the wing pattern were obtained, but not of the undertail coverts. In addition, the call is very different from that of *M. niger* and was heard clearly. At this point on the river there are rocky hills and inselbergs on both banks. The hills in this area support a sparse *miombo* woodland, with areas of denser woodland and semi-evergreen thicket with scattered large trees, especially on the pediments of the inselbergs. *M. leucomelas* was observed on another inselberg in this locality close to the Ruvuma River in Mozambique, but was not identified elsewhere in the eastern part of Niassa National Reserve.

Since this record of *M. leucomelas* is within the range of *M. niger* indicated by Baker & Baker (2018), it seems that the ranges of the two species overlap, or at least meet, especially where the *miombo* and dry woodlands interdigitate. In this respect, it is of interest that another southern species, the Southern Red-billed Hornbill *Tockus rufirostris* was observed extensively in the same dry woodlands in Niassa National Reserve as *M. niger*. The most northerly records were a few kilometres south of Litumbo (11°23′41″ S, 38°25′30″ E). Red-billed hornbills, unidentified to species, were recorded on the Ruvuma River terrace between Nyati (11°41′36″ S, 37°23′31″ E, 347 m asl) and Chamba (11°38′00″ S, 37°08′40″ E, 382 m asl), in which locality unidentified black tits were also observed. Since the habitat on the northern, Tanzanian, bank also appeared suitable for *T. rufirostris* (albeit degraded in parts by human activities) it would be expected to occur there. However, I never observed it on the northern bank during extensive field work along the Ruvuma River in Niassa, and the species apparently remains unrecorded in Tanzania.

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Group names for some *Euplectes* and *Vidua* species

For decades, several species of long-tailed *Euplectes* (family Ploceidae) and *Vidua* (family Viduidae) species have been referred to as 'widowbirds' and 'whydahs' respectively. However, over time, the use of these two vernacular names has varied between authors.

In East and southern Africa, the long-tailed *Euplectes* (formerly *Coliuspasser*) species have long been called 'widowbirds' (East Africa) or simply 'widows' (southern Africa), while the long-tailed *Vidua* and *Steganura* species have been called 'whydahs', with former *Hypochera* species 'indigobirds' or 'widowfinches'.

One factor long overlooked is that the correct English name for long-tailed *Euplectes* species is 'whydah', based on the type locality of *E. macroura* and the type species of the sub-genus *Coliuspasser*, i.e., the Ouidah (Whidah) kingdom of Benin (which covers much more than Ouidah itself). In French, all long-tailed *Euplectes* used to be called 'ouidah' as used by Douaud (1955); also see Delacour and Edmond-Blanc (1933–1934), and Dowsett-Lemaire and Dowsett (2019).

In translation, *vidua* is Latin for widow, so surely it is now appropriate for all long-tailed *Vidua* species to be referred to as 'widows' (in line with the French *veuve*), but to retain 'indigobird' for all former *Hypochera* species, and 'whydah' for all long-tailed *Euplectes* species. English vernacular names have long varied throughout the English-speaking world, but as the search for a unified nomenclature continues, some uniformity with French vernacular names would seem appropriate.

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First record of Ethiopian Bee-eater *Merops lafresnayii* for Somaliland

On 9 December 2021, while surveying the dry Geed Deeble riverbed/wadi (09°46′09″N, 44°00′56″E), Somaliland, on foot, a single bee-eater was spotted in riverside vegetation (Fig. 1). The bird was green above with a yellow throat, and had a distinct blue supercilium and forehead, distinctly blue (and black) gorget, and a chestnut breast, all features that distinguish it from the Little Bee-eater *Merops pusillus*. The blue gorget was clearly visible when viewed from the front rather than the side. Based on the relative size compared to the *Prosopis* leaflets (on the photo), its total length is estimated to be about 18 to 21 cm. It appeared to lack a distinct white wedge on the cheeks but otherwise closely matched the features of the Blue-breasted Bee-eater *Merops (variegatus) lafresnayii* as described by Redman *et al.* (2011). This taxon has recently been elevated to full species status by the international ornithological community as the Ethiopian Bee-eater *Merops lafresnayii* (Gill *et al.* 2021)

Figure 1. Ethiopian Bee-eater at the Geed Deeble Wadi, 9 December 2021 (photo: W. Giesen).

The Ethiopian Bee-eater *Merops (variegatus) lafresnayii* is considered a near-endemic species, largely confined to Ethiopia and Eritrea, but also occurring very marginally in South Sudan, and is common in a wide range of wooded habitats from 500 to 2500 m asl (Redman *et al.* 2011). The species has a large range, with a substantial and stable population and hence is listed as of 'Least Concern' (BirdLife International DataZone 2021). It occurs mainly in highland areas and is considered to be largely sedentary. There are rather few records east of 40° E in Ethiopia (Ash & Atkins 2009).

The bird was perched in a grove of the invasive shrub *Prosopis juliflora* lining the low banks of the dry wadi, which is further characterized by *Balanites glabra, Maerua crassifolia, Vachellia (Acacia) tortilis* and *Zizyphus mucronata*, often festooned with the climber *Cissus rotundifolia*. The location is about 20 km north of Hargeisa, the capital of Somaliland, at an altitude of 1090 m. This is slightly lower than the altitude of nearby Hargeisa (1350 m), which receives around 400 mm of rainfall a year. Rainfall amount at the Geed Deeble Wadi is likely to be slightly lower.

Extensive livestock grazing and browsing is the main type of land-use in this area and there are many pastoralist families herding goats, sheep, dromedary camels and donkeys. Market gardening occurs on a limited scale near local borehole sites where several large, fenced-off areas have been developed for the cultivation of cash crops such as watermelon, onion, mango and lemon. These are all irrigated by pumped groundwater and located at least several kilometres from the site where the bird was observed.

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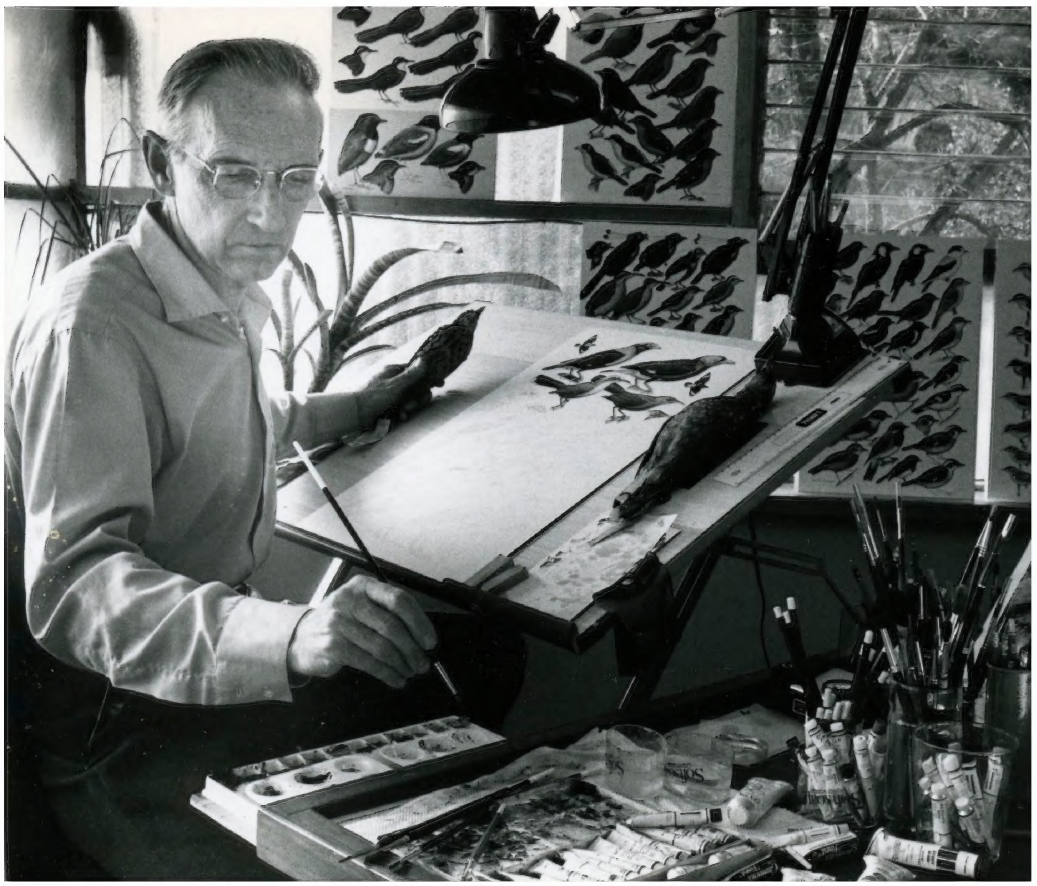
Dale Allen Zimmerman
(1928–2021)



Dale Zimmerman passed away peacefully in his sleep on Wednesday 10th November 2021. He was an extraordinary person, not only was he an accomplished ornithologist, lepidopterist and botanist, but also an extremely talented bird artist and photographer.

Born on 7 June 1928, in Imlay City, Michigan, USA, he was educated there and at the University of Michigan whence he received his doctorate in 1952. He married Marian Jeanette Allen in July 1950 and in 1957 they moved to New Mexico for Dale to take up a teaching position at the Western New Mexico University in Silver City, where he taught biology, ornithology, zoology, and systematic botany from 1957 to 1988. He later became Chair and Professor Emeritus of the Botany Department, whose herbarium is named in his honour.

By the age of six Dale was already fascinated by birds, insects and African wildlife, and constantly dreamed of visiting Africa, but it was not until 1961 that he embarked on the first of his many visits to Kenya. On return to Silver City, Dale's only thought was how he could get back, and it was only two years later that he received a

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grant from the American Museum of Natural History to undertake a census of birds of the Kakamega Forest in western Kenya, and so in 1963 he and Marian made their first visit together, and his census work at Kakamega began in earnest. In 1965 and 1966 he received further grants from the National Science Foundation that enabled him to continue working at Kakamega for several more years, culminating in 'The avifauna of the Kakamega Forest, including a bird population study' published in the *Bulletin of the American Museum of Natural History* in 1972. It remains today as the standard reference work on the birds of Kakamega Forest.

Constantly aware of the need for a first-class field guide to the birds of Kenya and the East African region as a whole, Dale discussed with David Pearson and me whether we could bring such a need to reality. First, it was essential to bring on board a major publishing house, and after many weeks and months an agreement was reached with A&C Black in the UK, Princeton University Press in the USA, and Russell Friedman in South Africa. Then, in the early 1980s, there began the hard work of composing and painting over a hundred colour plates and spending many days both in museums around the world as well as on safari in Kenya and northern Tanzania. Finally, some 15 years later, *The Birds of Kenya & Northern Tanzania* was published and another of Dale's dreams had come true.

In total, Dale authored well over 100 publications, primarily on birds, plus a few on plants and mammals. His major works included *The Birds of New Guinea*, co-authored with Bruce Beehler and Thane Pratt in 1986, and *The New Mexico Bird Finding Guide* in 1992. He was a former Associate Editor of the AOU Monograph series and of *Western Birds*. He also served for several years on the Editorial Board of *American Birds*, and as a member of the Board of Directors of the American Birding Association. In 1989 he was elected as a Fellow of the American Ornithologists' Union, and in 2015 received the prestigious Ludlow Griscom Award from the American Birding Association for his contributions to ornithology. Also in 2015, and in memory of his wife Marian who had passed away in 2011, *Turaco Country* was published, a 780-page composition of reminiscences of their East African safaris together, complete with several hundred of their magnificent photographs.

Despite a long and heroic battle with rapidly deteriorating eyesight, Dale (accompanied by his travelling companion and fellow photographer Carol Ann Fugagli) was able to undertake several further visits to his beloved Africa, and to Kenya in particular, from 2016 through to late 2018. His passion for East Africa and its birds continued throughout his long and productive life, and his endless enthusiasm has inspired so many here in Kenya, in particular the many young Kenyan birders who study the plates in his book so diligently.

Determined to continue with his writing, Dale and I exchanged regular (at times daily) e-mails until early October 2021, but following a stroke in early November it was evident that his dream of one day returning to Kenya was not to be. In accordance with his wishes, though, his and Marian's ashes ('the Zimmermanian molecules') will later be scattered at a few of their favourite African locations.

Rest in peace dear friend and thank you for so many memorable times spent together, either in New Mexico or on safari in Kenya.

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